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ENVIRONMENTAL ASSESSMENT OF NISA: FINAL REPORT

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EXECUTIVE SUMMARY

In May, 1992, Agriculture Canada contracted with Environmental Management Associates (EMA) to conduct an environmental assessment of the Gross Revenue Insurance Program (GRIP) and the Net Income Stabilization Account (NISA), as required under the 1991 Farm Income Protection Act (FIPA). This document, which addresses NISA, includes a review of primary environmental issues in Canadian agriculture and specific issues relating to NISA, a description of how the assessment was conducted, and what the study concluded.

Primary Assessment Issues

"National" environmental issues facing Canadian agriculture were identified largely based upon information from the **Report to Ministers of Agriculture by the Federal-Provincial Agriculture Committee on Environmental Sustainability** (June 30, 1990). Included were concerns over soil degradation, surface and groundwater quality, destruction of wildlife habitats by agricultural activities, air quality and climate issues such as global warming. These "national" issues helped to establish the general context for both the "provincial/regional" issues and several specific assessment issues for the NISA environmental review. The emphasis on concerns varied among provinces but the themes of soil degradation, wildlife habitat losses and water quality were common to most provinces.

Specific environmental issues associated with NISA included the environmental implications of potential distortions in land use, crop selection including forages, chemical use and cultivation practices. Among the possible impacts associated with NISA, the most attention was focused on soil erosion, water quality and wildlife habitat, including wetlands.

How Was the Review Conducted?

The assessment included three basic elements to address the identified NISA-related environmental issues. The first involved a theoretical analysis of how NISA functioned across Canada. Secondly, a descriptive assessment was based on a mail survey of almost 10,000 farmers across Canada; the overall response rate of 64% was considered excellent, with Provincial rates ranging from 58% in Saskatchewan to 74% in Ontario. Additionally, structured interviews with resource professionals were held across Canada to solicit opinions on NISA and further contributions were obtained through written submissions from the public and interested organizations. The last element was the use of the Erosion Productivity Impact Calculator (EPIC) to evaluate soil erosion and water quality concerns.

What Did the Study Conclude?

The scope of this environmental assessment was confined to the period immediately preceding the introduction of NISA and the first two years of NISA's operation. It was intended to measure the incremental change in environmental performance because of

NISA. It was not an evaluation of the implications of farm support systems versus no farm support systems. This was the case as Canada has a long-standing history of farm support systems such as crop insurance, WGSA and various ad hoc programs dating back over 30 years.

NISA is a form of self insurance through management of a financial reserve. Any funds drawn from this account result in less money being available when the farmer retires. The farmer thus has an incentive to manage any account payouts in the context of a reduced retirement annuity. These incentives should result in similar motivations and decisions with respect to input use, crop selection and livestock production as if there were no farm support programs. It is likely that the environmental performance of NISA under a whole farm program would be comparable to that associated with a market driven allocation of resources.

It should be emphasized that market influences likely have a greater influence on farmer behaviour regarding crop selection and land use activities than a program such as the existing NISA. Evidence of this is present from the 1970's when high grain prices led to widespread and large-scale conversion of marginal lands and wetlands in order to bring more land into production. Indeed, it was the environmental consequences of that period that led directly to heightened awareness to the importance of soil conservation and wetland protection. This is not to downplay the identified impacts of NISA but rather, to point out that the market may play a more dominant role in dictating environmental impacts than those identified in this study.

HAS NISA AFFECTED CROPPING AND LAND USE DIVERSITY?

Crop and land use diversity is considered to be important because a more diverse crop mixture should help insulate farmers from the vagaries associated with adverse growing and market conditions. Additionally, greater land use diversity is considered valuable because of the variety of environments available to Canada's flora and fauna.

The majority of farmers did not believe that farming was less risky with NISA. As a risk management tool, NISA accounts were generally too small to provide a sufficient reserve for self insurance. Rather, most farmers at this time are relying upon expanded land bases or livestock operations as a source for income growth and stability. Depending on the province, between 3% and 18% of farmers indicated that NISA influenced crop selection. Judging by the results provided by the concurrent assessment of GRIP, it is likely that this influence was reflected in farmers switching to crops such as spring wheat with higher target revenues. However, this was not at the expense of cultivating grassland or other forages but rather, a re-allocation of crops such as oats and a reduction in summerfallow, particularly in the Prairie Provinces.

Theoretically, a self-insurance strategy such as NISA could substitute for cropping diversification as a risk management tool. However, this theory is predicated upon the NISA

account having sufficient funds to replace options such as livestock operations and off-farm income as a source of income stability. Specialization can result in reduced costs through economies of scale. Knowing that a NISA account with sufficient funds could provide income stability could encourage farmers to incur the risks in return for the potential increased income associated with the reduced costs of more specialized farming operations. This study did not reveal that increased specialization was occurring as most farmers did not believe that NISA provided an adequate financial reserve to allow such behaviour. A companion analysis of land use diversity based on Canada Census data and the farmer surveys revealed that overall land use diversity did not decrease during the period of assessment. Thus, given that only a small proportion of farmers indicated being influenced by NISA to switch crops and that this switching was among primarily other grain crops, **we concluded that the overall impact of NISA on cropping and land use diversity was a negative, negligible, short-term impact.** We considered it a short-term impact because a changing market will influence cropping diversity.

HAS NISA AFFECTED THE LIVESTOCK SECTOR?

Given that NISA contributions are tied to sales of only eligible crops, excluding forages, NISA could affect the livestock sector in two ways. Under circumstances where NISA account balances became large enough to provide an adequate revenue resource to reduce risk, farmers might reduce livestock operations if these operations are more expensive than drawing upon the NISA account to stabilize farm income. This study revealed no evidence of this occurring.

Secondly, livestock operations could be reduced if the financial assistance provided to the livestock industry is less attractive than that afforded by NISA. The livestock industry does receive support through existing tripartite agreements and indirect program support to forage production, but the issue is one of relative support. Contributions to NISA accounts exclude all but those associated with GRIP-eligible crops. Thus, contributions cannot be made based on forage sales. Despite this, in its first two years of operation, NISA does not appear to have reduced forage production. Indeed, forage production increased during this period. This is thought to be related to a relatively prosperous livestock sector and domestic supply requirements for forages.

Exclusion of certain agricultural receipts from being eligible for NISA account contributions diminishes the potential balance in those accounts. Lower balances reduce that account's ability to provide self-insurance for farming operations and places a stronger reliance upon external means such as crop insurance and revenue insurance through GRIP to manage risk on the farm. Whole farm coverage would allow greater contributions to NISA accounts, thereby reducing the reliance upon or replacing these other risk reducing options.

HAS NISA AFFECTED SOIL EROSION AND NON-POINT SOURCE POLLUTION?

Accelerated soil erosion arises when soils are exposed to the influences of wind or water. This erosion removes topsoil and can decrease soil productivity and increase non-point source pollution through the introduction of nutrients, fertilizers and pesticides into receiving waterbodies.

Summerfallow acreage in the Prairies was reduced by 6% (over 500 000 ha) during NISA's first two years and farmers in almost all study areas indicated they were influenced by NISA to reduce their use of summerfallow. NISA also influenced an increase in the use of conservation tillage practices across Canada, with expected associated decreases in erosion. Of interest, was the response by farmers across the country that NISA influenced them to increase their acreages of forage crops despite the fact that NISA offers no economic incentives to do so. Parallel analyses using EPIC simulations revealed that environmental impacts of NISA as measured by mm of soil eroded per year were negligible (a fraction of a mm per year). NISA did not appear to pose a threat to sustained soil productivity or increased non-point source pollution even when farming systems as practised under NISA conditions were simulated for over 100 years.

On balance then, there was compelling evidence that NISA could be considered in its first years of operation to have had **a positive, minor, short-term impact in terms of reduced potential for soil erosion and non-point source pollution**. The degree to which this will hold true for the longer-term is less certain because land use practices might change with a changing market. Nonetheless, simulations suggest that existing farming practices will result in sustained soil productivity for the foreseeable future.

HAS NISA INFLUENCED THE USE OF CHEMICALS AND AFFECTED WATER QUALITY?

As described above, water quality can be affected by introduction of nutrients and other farm products into receiving waterbodies.

Farmer surveys revealed that NISA had no appreciable impact on the use of either fertilizers or pesticides. Thus, impacts on water quality relating to these practices were unlikely. EPIC simulations confirmed no existing or projected increases in non-point source pollution. Conservation farming practices identified under the NISA regime should actually lead to reduced erosion and improved water quality. However, given that these improvements would be difficult to detect on a broad geographic basis, it was concluded that **NISA had a positive, negligible, short-term impact on water quality.** Again, we considered the impact short-term because a changing market could result in changing land use and input use practices.

HAS NISA AFFECTED WILDLIFE HABITAT INCLUDING WETLANDS?

Farming activities have the potential to decrease wildlife habitats through wetland drainage or cultivation of grassland habitats or conversely, to increase them through conservation-tillage or planting of forage crops.

As far as wetland habitats are concerned, 16% of survey respondents indicated that they had drained wetlands between 1990 and 1992, although the proportion of farmers that attributed this drainage to NISA was small (less than 6% of those that drained wetlands). This provides strong evidence that wetland drainage continued through 1991 and 1992 and that rather than being solely responsible for this drainage, NISA exacerbated it. There was little evidence that NISA influenced farmers to disturb wetland margins, the zones around wetlands which contribute to wetland functional capability. Despite the fact that the proportions of farmers influenced to drain wetlands was likely small and the number and surface areas of affected wetlands was also small, continued long-term degradation of wetlands is likely to lead to more serious problems.

Thus, given Canada's dwindling wetland resource, Canada's position on "no net loss of wetland function", the vulnerability of continental waterfowl populations which rely upon wetlands and their margins, and the stated objectives of the North American Waterfowl Management Plan to increase wetland habitats and waterfowl populations, **the degradation of Canada's wetland resource because of NISA was concluded to be a negative minor impact in the short-term, but could lead to a negative moderate/major impact in the long-term because of incremental wetland losses**. Given this adverse impact, mitigation measures are recommended. For example, Canada should give consideration to approaches to wetland conservation such as "swampbuster" which has been implemented for U.S. farm programs. This concept should be supplemented with incentives to encourage wetland conservation and creation, and should allow for a net gain of wetlands rather than continued degradation of this valuable resource.

For upland habitats, NISA evidently did not adversely affect grassland or woodland areas in terms of converting them to cultivated lands. Indeed, there was an increase in forage crop acreage which would be beneficial to wildlife. Similarly, the reduction in summerfallow acreage and the adoption of more conservation tillage practices would also be advantageous to wildlife. NISA did, however, influence a small proportion of farmers in Saskatchewan, Manitoba, Ontario and Prince Edward Island to reduce field margins and farmers in each Prairie Province to reduce riparian zones. Despite some declines in upland habitat, there were compensatory increases in other provinces and changes in land use practices (e.g., less summerfallow, more forages) that would suggest that for Canada as a whole, **the impact of NISA on upland habitat was negative, negligible and long-term.** This conclusion is not intended to suggest that the identified degradation is acceptable. Rather, mitigation measures such as "sodbuster" should be directed at slowing or halting further loss of these habitats. By invoking such measures, coupled with incentives to encourage more of the

identified gains associated with conservation tillage etc., we could begin to see an accrual, rather than a loss of wildlife habitat, similar to what is occurring in the United States.

HAS NISA AFFECTED AIR QUALITY?

Air quality could be affected by dust arising from soils exposed to wind erosion or through greenhouse gases such as carbon dioxide being released from cultivated lands.

As described above, soil erosion has been reduced under NISA, which should result in improved air quality through a reduction in wind borne dust. The increase in conservation farming practices and increased forage acreage could also contribute to reduction in carbon dioxide which would otherwise be emitted from summerfallow lands. It would, however, be difficult to detect these improvements in air quality and **thus, NISA was considered to have positive, negligible, short-term impacts on air quality.** As with water quality, a changing market could result in changing land use and input use practices; hence the designation as a short-term impact.

OVERALL ENVIRONMENTAL IMPLICATIONS OF NISA

When all the environmental performance measures were considered, it was determined that the impacts of NISA were both positive and negative, and in some instances neutral. In no instance, however, were those impacts determined to be more than minor in nature, on an impact evaluation scale ranging from negligible through minor, moderate to major.

Based on an evaluation of the first 2 years of NISA, NISA's cumulative impact was considered to have been negative and minor, a conclusion triggered by the degradation of wetlands. This degradation, albeit small in scale, was considered to be sufficiently important because of stated Canadian policies for wetland protection, to supersede the several positive impacts of NISA.

A variety of measures are proposed to offset negative environmental impacts of NISA. These include stronger regulations relating to Canadian versions of "swampbuster" and "sodbuster", that could be delivered through means such as restricting government contributions to NISA accounts under circumstances such as wetland drainage or for annual crops grown on Class 4, 5 and 6 lands. More incentive-based approaches to cross-compliance are also recommended such as enhancing government contributions to NISA accounts conditional upon farmers meeting environmental protection objectives through the filing of approved farm conservation plans.

A further evaluation of NISA's implications to wetlands and other environmental issues will be the focus of the next environmental assessment after 5 years of NISA.

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TABLE OF CONTENTS

PAGE

EXECUTIVE SUMMARY i
AUTHORSHIP AND ACKNOWLEDGEMENTS vii
TABLE OF CONTENTS viii
LIST OF TABLES xiii
LIST OF FIGURES xiv

1.0 INTRODUCTION 1
1.1 BACKGROUND 1
1.2 OBJECTIVES 3
1.3 NET INCOME STABILIZATION ACCOUNT (NISA) 3

2.0 ENVIRONMENTAL ASSESSMENT ISSUES 7
2.1 NATIONAL ISSUES 7
2.2 PROVINCIAL/REGIONAL ISSUES 11
2.2.1 British Columbia 11
2.2.2 Alberta 12
2.2.3 Saskatchewan 12
2.2.4 Manitoba 13
2.2.5 Ontario 14
2.2.6 Quebec 16
2.2.7 New Brunswick 16
2.2.8 Nova Scotia 16
2.2.9 Prince Edward Island 17
2.2.10 Newfoundland 17
2.2.11 Summary 18
2.3 SPECIFIC ENVIRONMENTAL ASSESSMENT QUESTIONS FOR NISA 18
2.3.1 Land Use and Cropping Diversity 18
2.3.2 Marginal Lands, Wetlands and Wildlife Habitat 20
2.3.3 Impacts on Livestock Sector and Diversification 21
2.3.4 Cultural Practices and Innovation 22
2.3.5 Soils 22
2.3.6 Whole Farm Coverage 22
2.3.7 Other Evaluation Questions 23
2.4 SUMMARY 23

TABLE OF CONTENTS CONTINUED

			PAGE
3.0		ANALYTICAL FRAMEWORK FOR THE ASSESSMENT	24
	3.1	INTRODUCTION	24
	3.2	DATA ACQUISITION	27
	3.2.1	Primary Data	27
	3.2.2	Secondary Data	31
	3.3	LAND/INPUT USE CHANGE	31
	3.4	THEORETICAL ASSESSMENT	31
	3.5	DESCRIPTIVE ASSESSMENT	32
	3.5.1	Wildlife	32
	3.6	SIMULATION STUDIES USING EPIC	36
	3.7	SYNTHESIS AND INTEGRATION OF FINDINGS	42
	3.8	MITIGATION MEASURES	43
4.0		THEORETICAL AND CONCEPTUAL ASSESSMENT	44
	4.1	INTRODUCTION	44
	4.2	RISK	44
	4.2.1	Measuring Risk	45
	4.3	APPROACH TO RISK MANAGEMENT	49
	4.3.1	Other Risk Management Strategies	49
	4.3.1.1	Diversification	50
	4.3.1.2	Information	50
	4.3.1.3	Insurance	50
	4.3.1.4	Moral Hazard and Adverse Selection	51
	4.4	RISK MANAGEMENT AND NISA	56
5.0		DESCRIPTIVE ASSESSMENT	59
	5.1	INTRODUCTION	59
	5.2	PRIMARY INFORMATION	59
	5.2.1	Written Briefs	59
	5.2.2	Interviews With Resource Personnel	59
	5.2.3	Mail Survey	59
	5.2.3.1	Crop Mix	64
	5.2.3.1.1	NISA and Risk Reduction	64
	5.2.3.2	Herbicides	65
	5.2.3.3	Fertilizers	66
	5.2.3.4	Tillage Practices	66

TABLE OF CONTENTS CONTINUED

		PAGE
5.2.3.4.1	Alberta	67
5.2.3.4.2	Saskatchewan	67
5.2.3.4.3	Manitoba	67
5.2.3.4.4	Ontario	68
5.2.3.4.5	British Columbia	68
5.2.3.4.6	Atlantic Provinces	68
5.2.3.5	Summerfallow Acreage	68
5.2.3.5.1	Alberta	69
5.2.3.5.2	Saskatchewan	69
5.2.3.5.3	Manitoba	69
5.2.3.5.4	British Columbia	69
5.2.3.6	Summerfallow Cultivation Practices	70
5.2.3.6.1	Alberta	70
5.2.3.6.2	Saskatchewan	70
5.2.3.6.3	Manitoba	70
5.2.3.6.4	British Columbia	70
5.2.3.7	Riparian Zones	70
5.2.3.7.1	Alberta	71
5.2.3.7.2	Saskatchewan	71
5.2.3.7.3	Manitoba	71
5.2.3.7.4	Ontario	71
5.2.3.7.5	British Columbia	71
5.2.3.7.6	Atlantic Provinces	71
5.2.3.8	Field Margins	72
5.2.3.8.1	Alberta	72
5.2.3.8.2	Saskatchewan	72
5.2.3.8.3	Manitoba	72
5.2.3.8.4	Ontario	72
5.2.3.8.5	British Columbia	73
5.2.3.8.6	Atlantic Provinces	73
5.2.3.9	Wetland Margin Degradation	73
5.2.3.9.1	Alberta	73
5.2.3.9.2	Saskatchewan	73
5.2.3.9.3	Manitoba	73
5.2.3.9.4	Ontario	74
5.2.3.9.5	British Columbia	74

TABLE OF CONTENTS CONTINUED

			PAGE
	5.2.3.9.6	Atlantic Provinces	74
	5.2.3.10	Wetland Drainage	74
	5.2.3.10.1	Alberta	74
	5.2.3.10.2	Saskatchewan	74
	5.2.3.10.3	Manitoba	75
	5.2.3.10.4	Ontario	75
	5.2.3.10.5	British Columbia	75
	5.2.3.10.6	Atlantic Provinces	75
	5.2.3.11	Perennial Forages	75
	5.2.3.12	Summary	76
	5.3	CROP SPECIES/LAND USE DIVERSITY	83
6.0	SIMULATION STUDIES TO ASSESS SOIL EROSION		87
	6.1	SOIL EROSION, SOIL PRODUCTIVITY AND NONPOINT SOURCE POLLUTION (NPSP)	87
	6.2	SUMMARY AND CONCLUSIONS	94
7.0	SYNTHESIS, CONCLUSIONS AND RECOMMENDATIONS		95
	7.1	ASSESSMENT OF ENVIRONMENTAL ISSUES	95
	7.1.1	Risk Management	95
	7.1.2	Agriculture Diversification and Market Neutrality	95
	7.1.3	Land Use	96
	7.1.3.1	Land Use/Cropping Diversity	97
	7.1.3.2	Summerfallow	97
	7.1.3.3	Marginal Lands and Wildlife Habitat Including Wetlands	97
	7.1.3.4	Soil Erosion and Non-point Source Pollution	99
	7.1.4	Chemical Use and Water Quality	99
	7.1.5	Air Quality	100
	7.2	RECOMMENDATIONS/MITIGATION MEASURES	100
	7.2.1	Recommendations From Written Submissions	100
	7.2.2	Environmental Cross-Compliance	101
	7.2.2.1	What is Environmental Cross-Compliance?	101
	7.2.2.2	NISA and Cross-Compliance	102
	7.2.2.3	The U.S. Experience With Cross-Compliance	103

TABLE OF CONTENTS CONCLUDED

PAGE

7.2.2.4	Considerations for Implementation of Cross-Compliance in Canada	105
7.2.3	Delivery of Cross-Compliance Under NISA	109
7.2.3.1	Withholding NISA Contributions	109
7.2.3.2	Restricting NISA Contributions	110
7.2.3.3	Enhancing NISA Contributions	110
7.2.4	Alternative Options	111
7.2.4.1	Ad Hoc Measures	111
7.2.4.2	NISA Program Changes	112
7.2.5	Environmental Monitoring Programs	114
7.2.5.1	Introduction	114
7.2.5.2	Land Use	114
7.2.5.3	Soil Degradation and Non-Point Source Pollution	115
7.2.5.4	Wildlife Habitat Changes	116
7.2.5.5	Surface Water Quality	117
7.2.6	Information Deficiencies/Future Study Needs	119
7.2.6.1	Introduction	119
7.2.6.2	Further Characterization of Farmer Attitudes and Characteristics	119
7.2.6.3	Land Use and Soil Productivity and NPSP Risk	120
7.2.6.4	Wildlife Habitat	121
7.2.6.5	Other Issues	122
7.3	SUMMARY	123
8.0	REFERENCES	129

APPENDICES

APPENDIX I	Scope of Work
APPENDIX II	Individuals Interviewed for GRIP/NISA Environmental Scoping Assessments
APPENDIX III	Mail Surveys Used in Assessment
APPENDIX IV	Summaries of Letters and Briefs
APPENDIX V	Summary Tables From Mail Survey

LIST OF TABLES

		PAGE
TABLE 3.1	Mail Survey Activity and Mailing Date of Activity	30
TABLE 5.2.3.1	Mail Survey Results for the GRIP/NISA Questionnaire	62
TABLE 5.2.3.2	Mail Survey Results for the NISA Questionnaire	63
TABLE 5.2.3.12.1	Summary of the Estimated Impacts of NISA on Farming Practices and Land Use Decisions in 1992	77
TABLE 5.2.3.12.2	Percent Change in Areal Coverage of Woodlands/Shrublands and Grasslands Between 1990 and 1992 for Farmers Enrolled in NISA Only	82
TABLE 5.3.1	LUDI Calculated Using Agricultural Census Data (Results)	84
TABLE 5.3.2	LUDI Calculated Using EMA Survey Data (Results)	85
TABLE 6.1	Cumulative Impact of Seven Prevalent Farming Systems as Influenced by NISA as of 1992 for Each Reporting Area	89
TABLE 7.3	Summary of the Impacts of the 1992 NISA Program on Farming Practices and Land Use Decisions	125

LIST OF FIGURES

		PAGE
FIGURE 2.1	Environmental Issues in the Canadian Agri-Food Sector	19
FIGURE 3.1	Environmental Assessment Framework	25
FIGURE 3.2	Data Sources Used to Construct the Baseline EPIC Datasets	39
FIGURE 4.2.1	Uniform and Normal Distributions of Incomes	46
FIGURE 4.2.2	Illustration of the Probability Distribution of Income With and Without NISA	48
FIGURE 4.3.1	Probability Distribution of Income With and Without C.I.	52
FIGURE 4.3.2	Moral Hazard, Spring Moisture and Commodity Prices	54
FIGURE 5.2.1	Environmental Issues Related to NISA Based on Written Submissions	60

1.0 INTRODUCTION

This document reports on the final outcome of the environmental review of the Net Income Stabilization Account (NISA), based on its first two years of operation. This review was required under the terms of the federal Farm Income Protection Act (FIPA), and has no direct link with the Federal Environmental Assessment Review Process (EARP), nor with the Canadian Environmental Assessment Act.

Environmental assessments of physical projects such as dams or bridges have become commonplace in Canada, because of the recognized potential for such large physical works to alter the environment in ways that may be detrimental. Such assessments are generally carried out before the project is constructed. In contrast, it is less common to assess the environmental impacts of something as intangible as a farm income insurance or stabilization program, particularly after the program has been approved and implemented. Yet that is what this report is about.

The explanation for this unprecedented decision to review the environmental impacts of NISA is straightforward:

- Agriculture Canada is committed to ensuring that its policies and programs are compatible with the imperatives of environmental sustainability and sustainable development;

- The normal environmental screening of NISA during the design phase prior to implementation, while generally positive, left some uncertainty because the level of farmer participation in NISA and their management response to the new program were unclear.

1.1 BACKGROUND

Within Canada's agricultural regions a high proportion of the land area is directly managed by farmers and ranchers. Their decisions about land use, choice of crops, selection of tillage methods, management of agricultural chemicals, and many other factors, have consequences -- both positive and negative -- for the environment.

Farmers' decisions on what and how to produce are influenced by many factors such as local soil and climate conditions, historical and expected commodity prices, etc. The incentives and disincentives provided by agricultural policies and programs may also be important determinants of producer behaviour, and may therefore be indirectly linked to the environmental impacts (both positive and negative) associated with agricultural production. This is especially true of farm income insurance and stabilization programs during extended periods of low or declining commodity prices, when the net benefits received under the programs tend to be relatively large compared with market receipts.

Historically, insurance and stabilization programs such as crop insurance and Western Grain Stabilization have attracted periodic criticism because of their alleged incentives to use land in unsustainable ways. Today the challenge is one of stabilizing farm incomes without inadvertently rewarding farmers for actions that are incompatible with sustainable development or with current environmental policy.

Considerable attention was paid to environmental questions in the course of developing the new generation of farm income safety net programs -- the Gross Revenue Insurance Plan (GRIP) and the Net Income Stabilization Account (NISA). A preliminary evaluation of the likely environmental impacts of these new programs reached no definitive conclusions, although certain features of the new programs were felt to be improvements over the older crop insurance and stabilization programs. At the same time, because of the potential magnitude of the subsidies to farmers under these programs, and because GRIP subsidies are not fully decoupled from the production of specific commodities, it was recognized that distortions in land use leading to environmental damage could result. Consequently, when the Farm Income Protection Act (FIPA -- the enabling legislation for GRIP, NISA, crop insurance, etc.) was being drafted, clauses were included to mandate periodic environmental reviews. Specifically, FIPA required that the federal-provincial agreements for every program implemented under the Act:

> 5(2)(a) provide for the circumstances and conditions under which insurance may be withheld, restricted or enhanced for the purpose of protecting the environment and of encouraging sound management practices to ensure environmental sustainability; and
>
> 5(2)(b) require an environmental assessment of the program to be conducted within two years after the coming into force of the agreement and every five years thereafter, and provide for the manner in which the assessment is to be conducted.

Congruent with these requirements, the federal-provincial agreements for the newly developed GRIP and NISA contained clauses which defined the understanding attained between federal and provincial governments with regards to these activities (see sections 19.1 to 19.4 of the National Agreement Establishing a Tripartite Gross Revenue Insurance Plan and Sections 6.6 and 6.7 of the Federal-Provincial Agreement Establishing the Net Income Stabilization Account Program). Specifically, both agreements called for an environmental assessment within two years of the agreements coming into effect. Consequently, in May 1992, Agriculture Canada contracted Environmental Management Associates to conduct environmental assessments of GRIP and NISA.

Potential environmental assessment issues related to the NISA program involve changes in the environment indirectly linked to the program. Some changes may tend to stabilize agro-

ecosystems while others will be destabilizing. This assessment will not provide a definitive answer to the question of whether the production of grains and oilseeds in Canada is environmentally sustainable; rather, it will assess whether NISA-induced changes are a stabilizing or a destabilizing influence on selected components of agro-ecosystems and the broader environment. Conceptually, a precondition for NISA to have environmental impacts is that some of the program participants must behave differently after entering into NISA contracts with the government.

1.2 OBJECTIVES

Precise objectives are detailed in the Scope of Work (see Appendix I). In general, the main objective was to ascertain whether NISA, during its first two years of operation, influenced farmers to modify their crop selection, land use, chemical use and management practices in a way that would result in harmful impacts to wetlands, wildlife habitat, soils, water quality or air quality.

A key objective was to keep the assessment as realistic as possible, by comparing what actually happened before NISA, with what actually happened after the introduction of NISA. Hypotheses regarding environmental impacts that might have occurred in the complete absence of any safety net program were considered to be both unrealistic and essentially impossible to assess without a great many additional assumptions and hypotheses about support programs for other assumptions and hypotheses about support programs for other commodities (red meats; horticulture) both domestic and foreign. The emphasis throughout this report is therefore on relative incremental changes in the environment induced by NISA, rather than on absolute total measures of environmental impact.

There were three additional objectives in this assessment. One was to provide farmers themselves with an opportunity to directly participate in the review, and to do so in a way that would permit statistically valid conclusions to be reached about the behaviour of the entire population of NISA program participants. The second objective was to allow for broad participation by any interested individual, farmer, farm organization or environmental interest group. This latter objective was achieved by inviting written submissions, while the former objective was accomplished by means of a mail out survey, following Dillman's (1978) Total Design Method.

The final objective was to produce a report suitable for submission to Ministers and to Parliament, containing recommendations on mitigation measures, environmental indicators, and a national monitoring program.

1.3 NET INCOME STABILIZATION ACCOUNT (NISA)

Under NISA, farmers will be encouraged to make contributions to their individual accounts, which will be matched by federal and provincial governments. By setting aside money from

high-income years, producers will be able to stabilize their revenues during low-income years. NISA will be linked to the Revenue Canada taxfiler system.

NISA was designed to meet the following characteristics:

- payment triggers should be based on a measure of a farm's total income shortfall, rather than shortfalls for specific commodities;
- payment triggering should be specific to the needs of the individual farmer;
- there should be no cross-subsidization between producers;
- producers should be assured of receiving back, at some point, their contributions plus associated government contributions and interest earned, so that producers should receive the benefits if, through good management, their stabilization requirements are reduced;
- there should be sufficient motivation to keep the funds in the account until required; and
- the program should be consistent with Canada's international trade obligations.

THE MECHANICS OF THE PROGRAM

NISA was introduced by the federal government in 1991 and implemented in terms of the financial records from the 1990 tax year. The program allows farmers to deposit money into individualized accounts and withdraw the funds when their farm income is low in relationship to previous years. Annual deposits are based upon the net sales of eligible commodities. Net sales represent the difference between total receipts and purchases of the same commodity. Farmers may make deposits of up to the lesser of 2% of eligible net sales or $5000 which will be matched by the federal and provincial governments. Farmers may make additional contributions of up to 20% of eligible net sales that is not matched.

The NISA account is divided into two separate funds. Fund 1 holds deposits made by the farmer and any accrued interest. Fund 2 holds the government contributions and the accrued interest. Both funds receive market interest rate, while all producer funds (Fund 1) receive an additional 3% interest bonus contributed by the federal and provincial governments.

Any individual reporting farm income, including landlords with sharecrop rental agreements, may be eligible to open a NISA account. Individuals may also participate through a corporation, cooperative or communal organization.

Generally, NISA applies to sales of grains, oilseeds, most specialty crops and edible horticulture crops which are not part of National Tripartite Stabilization Agreements. The program is slowly expanding to include additional commodities. Farm fed grain is covered through a series of coefficients that estimate grain consumed per dollar of livestock sales.

Funds can be withdrawn from the NISA account when either a farm's gross margin (net sales less eligible expenses) falls below the previous five-year average, or when an individual's net income is less than $10 000. All direct expenditures which are deductible for income tax purposes are eligible expenses except interest. Most capital costs eligible for income tax purposes are eligible NISA expenses except interest and capital costs allowances. Outlays for land rent, property taxes, salaries paid to family members and purchases of like commodities deducted from total commodity sales area also ineligible NISA expenditures. When either of the net income qualifier or the gross margin qualifier indicate an individual can withdraw funds from the account, the larger of the two amounts may be taken out. Accounts may not be overdrawn. Funds must first be withdrawn from Fund 2 and are taxable in the year they are withdrawn. After Fund 2 has been depleted, funds are taken out of Fund 1, and these are not taxable.

Producers may choose to leave their account untouched as long as the balance in the account is less than the average eligible net sales in the previous five years. If the balance is higher than this threshold, a farmer may refuse a withdrawal once every five years.

Account balances are limited to a ceiling of one and one-half times the lesser of the average eligible net sales of the farmer in the most recent five-year period, or $375 000.

Participants may opt out of the program at any time by providing written notice. They have the option of withdrawing all the money as a lump sum, or in a series of annual payments. Each annual payment must be at least twenty percent of the account balance at the time the written notice is received, plus accrued interest since the last annual payment.

In its first year, NISA was used to transfer federal financial assistance from the Farm Support and Adjustment Measures (FSAM I) program. An additional 1.5% of eligible grain sales was contributed by the federal government. The federal government also contributed an additional 1% either as a provincial contribution (for those provinces electing not to make a contribution the first year) or as an addition to a provincial contribution. For provinces making their full contribution the first year, the federal government contributed a bonus of 0.5% to producer accounts. Thus for participants in provinces making a contribution, grains producers received 5% of sales while horticulture producers received 3.5% of sales. In provinces not making contributions the first year, grains producers received 3.5% of sales and horticulture producers received 2% of sales. In addition, the withdrawal triggers were waived, allowing producers to withdraw money if they chose without going through the trigger mechanisms. Producers were also able to choose the best of three years to report sales - 1988, 1989, or 1990. Producers did not have to send in their contribution to receive the matching government funds.

The deadline for making application to the NISA program is six months after the end of the producer's tax year. For most individuals, this would be June 30. The deadline has been extended in both tax year 1990 and tax year 1991 and was set at July 31, 1993 for tax year 1992. Applications will be accepted up to December 31 of each year, with a 5% reduction in deposit entitlements for each month delay after the deadline.

2.0 ENVIRONMENTAL ASSESSMENT ISSUES

2.1 NATIONAL ISSUES

The principal environmental issues in Canadian agriculture were described in a 1989 report to federal and provincial Ministers of Agriculture, by the Federal-Provincial Agriculture Committee on Environmental Sustainability. The report identified 17 specific sub-issues, grouped under 8 headings as follows:

1. Agricultural Soil Resources
   - soil degradation
   - urban encroachment on farmland

2. Surface and Groundwater Quality
   - contamination by pesticides
   - contamination by nutrients
   - contamination by manure and other by-products
   - contamination by agricultural soil sediments

3. Water Quantity
   - excess or inadequate water supplies

4. Wildlife Habitat
   - conservation of habitat

5. Air and Climate
   - stratospheric ozone depletion
   - air quality
   - climate change

6. Energy
   - energy inefficiency
   - lack of alternative sources

7. Pollution and Waste Management
   - effects of pollution on agri-food sector
   - contribution of agri-food sector to industrial pollution

8. Genetic Resources
   - loss of genetic diversity
   - narrowing of the genetic base for agriculture

Similar issues were identified in the most recent State of the Environment Report for Canada (Environment Canada 1991).

Although there is some regional variation in the environmental problems, there are a few issues which are common to most agricultural regions of Canada. These are soil erosion, water quality concerns, destruction of wildlife habitat, and global warming (greenhouse gas emissions). The draining of wetlands is a national problem.

In general, the objective of the review was to assess whether, and to what extent, NISA was implicated in the above environmental issues during its first two years of operation.

Issue 1: Agricultural Soil Resources

The two sub-issues identified were Soil Erosion and Urban Encroachment. For the former, agricultural practices and inappropriate land use were cited as the chief causes of problems that are manifested in topsoil losses through wind and water erosion, organic matter loss in soil, soil structure degradation, decreased productivity, salinization and acidification.

The concern over urban encroachment relates to the conversion of higher quality agricultural land for industrial, residential or transportation purposes. Such conversions either result in direct loss of land or fragmentation of lands to a point where they are no longer practical to farm.

Issue 2: Surface and Groundwater Quality

Four sub-issues were identified: Contamination by Pesticides; Contamination by Nutrients; Contamination by Agricultural By-Products; and Contamination by Agricultural Sediment.

Despite pesticide contamination levels in water being generally below Canadian drinking water guidelines, concerns have been expressed about future levels and the implications of longer-term exposure to low levels of pesticides or their metabolites. Pesticide contamination could result from point sources (e.g., spills) or non-point sources such as run-off from agricultural fields.

Water contamination by nutrients is generally thought to be related to fertilizer application. although not a widespread problem, there are locations, particularly in Ontario, where this is becoming a problem. Beyond concerns for humans, high levels of phosphorous and nitrogen in water can lead to eutrophication and de-oxygenation of waterbodies which can have deleterious effects on aquatic life and also degrades the aesthetics of waterbodies.

Agricultural by-products, particularly livestock manure, can cause surface and groundwater contamination resulting from the way it is stored or disposed. This water quality degradation is manifested in elevated nutrient levels, introduction of toxic substances, depressed dissolved oxygen levels and impaired recreational opportunities.

Wind and water erosion can lead to increased sediment levels in receiving waterbodies. Sedimentation of waterbodies can lead to degradation of habitat for aquatic organisms,

increased treatment costs, increased maintenance for silt removal in water conveyance and storage areas, and release of contaminants in solution.

Issue 3: Water Quantity

The availability of an adequate and timely supply of good quality water was identified as being essential to agricultural production. Concerns here range from an excess of surface water in Atlantic Provinces and portions of Central Canada to a dearth of water in the Prairies. The issues lie in removing excess water in the spring to facilitate field activities, yet ensuring that there is sufficient water later in the year when precipitation is insufficient to meet stock watering, irrigation, and domestic and municipal needs. Surface water is not the only concern as some areas are reliant upon groundwater for their chief source of water and excessive withdrawals from aquifers may result in depressing groundwater tables. Additionally, drainage of surface waters reduces re-charge of aquifers with similar water table consequences.

Issue 4: Wildlife Habitat

The nature of the concern here was over the need to make agricultural and wildlife needs more compatible. Agricultural practices have, by and large, resulted in the degradation of wildlife habitats. This degradation has resulted from clearing of woodlands, cultivation of grasslands and drainage of wetlands. For example, less than 1% of the original tall-grass prairie in Western Canada remains (Environment Canada 1991). Conversion to agricultural uses has been cited as the cause for 85% of Canada's wetlands losses (op. cit.). In part, this habitat degradation has contributed to the attitude that agriculture and wildlife habitat are mutually exclusive. Recently, however, policies and programs such as the North American Waterfowl Management Plan are resulting in a dramatic philosophical change in this thinking.

Issue 5: Air and Climate

Three sub-issues were identified: Stratospheric Ozone Depletion; Air Quality; and Climate Change.

Agricultural contributions to these three issues stem from burning of fossil fuels, soil management, and activities such as clearing and burning, all of which produce greenhouse gases such as carbon dioxide, methane and nitrous oxide. These gases contribute to the trapping of heat in the atmosphere with the potential for affecting climates and thus agricultural production. At a more localized level, fossil fuel combustion and wind erosion can introduce air borne contaminants that compromise air quality.

Issue 6: Energy

The two sub-issues identified here were Energy Inefficiency and Lack of Alternative Sources of energy.

With regards to energy inefficiency, concerns were raised that agriculture consumes a substantial amount of energy either directly for activities such as fuelling machinery and indirectly through the use of fertilizers which are costly to produce from an energy perspective. Reducing energy expenditure would have environmental benefits coupled with profit margin improvement.

Concerns were raised about the almost exclusive reliance upon fossil fuels from energy security and environmental implication perspectives. Reliable and cost-effective energy alternatives are largely lacking despite a strong interest.

Issue 7: Pollution and Waste Management

The two sub-issues identified here were Effects of Environmental Pollution on the Agri-food Sector and the converse, Contribution of the Agri-food Sector to Environmental pollution.

For the former, concerns lie in whether environmental contaminants such as acid rain, air pollution, contaminated soils and water-borne contaminants are compromising the quality of agricultural products or even more seriously, precluding agricultural production in general.

For the latter, the agri-food sector is also a contributor to air, soil and water contamination arising from fossil fuels, fertilizers, pesticides and animal wastes. Additionally, the packaging material for agricultural products contributes substantially to solid waste disposal requirements in landfills.

Issue 8: Genetic Resources

Two sub-issues were identified, Loss of Genetic Diversity and Narrowing of the Genetic Base for Agriculture.

The concern here lies in the need to ensure that agricultural specialization or a propensity toward monoculture does not lead to reduced varieties of species. Similarly, intensive agricultural practices such as cultivation of grasslands or clearing of woodlands leads to habitat fragmentation which may compromise the viability of plant and animal populations.

Summary

Much of the information described above was consulted in the formulation of a document entitled "The State of Canada's Environment" (Environment Canada 1991). That document lists the principal environmental issues facing Canada's agricultural sector:

Land Degradation

- Soil erosion - wind and water related
- Soil compaction - leaves land subject to erosion
- Acidification - arising from excessive fertilizer inputs
- Loss of organic matter - arising from intensive cultivation
- Irrigation - fertilizer and pesticide leaching, sedimentation
- Drainage - diminished water quality, eutrophication, habitat loss
- Dryland salinity - aggravated by summerfallowing
- Summerfallow - leads to increased erosion and salinity

Crop Production

- Fertilizers - nitrate and phosphate contamination
- Pest control - improper use of pesticides, soil contamination
- Chemical control - bio-accumulation
- Biotechnology - genetic modification

Animal Production

- Manure management
- Waste management - contamination of surface and groundwaters

2.2 PROVINCIAL/REGIONAL ISSUES

2.2.1 British Columbia

The agricultural area of British Columbia is restricted to approximately 4 million hectares or only 5% of the Province's total land area. Most of this land lies along river valleys and it is in these valleys that the majority of the population resides. This juxtaposition of people

and agriculture contributes, in no small way, to the nature of environmental concerns in British Columbia.

Kline (1991) described the chief environmental issues facing British Columbia agriculture as:

- Livestock waste and pesticide contamination of surface and groundwater quality
- Organic soil subsidence
- Soil compaction on highly productive land
- Soil erosion

While some of these issues are common to all agricultural regions of the Province, others are confined to just one location. Kline (1991) described that Water Quality was a concern in all four regions while Organic Subsidence and Soil Compaction issues were confined to the South Coastal region. Soil erosion was an issue in the Peace River and South Coastal regions. The only issue of concern for the Central Interior and Okanagan regions was water quality.

2.2.2 Alberta

The agricultural land base in Alberta comprises approximately 10 million hectares of cropland and another 10 million hectares of pasture and rangeland (Toogood 1989). Environmental issues pertaining to agriculture vary among regions in the Province but cumulatively include:

- Wind erosion
- Water erosion
- Organic matter loss
- Salinization
- Wildlife habitat loss

2.2.3 Saskatchewan

Saskatchewan's land area comprises some 65 million hectares, of which almost 27 million are devoted to agriculture (Saskatchewan State of the Environment Report 1991). In 1986, approximately 18 million hectares were devoted to cropland, with the balance largely composed of pasture and rangeland.

Like other provinces, Saskatchewan participated in the Federal-Provincial Agricultural Committee on Environmental Sustainability. At a workshop in 1991, stakeholders from Saskatchewan gathered to evaluate and rank Saskatchewan-specific concerns relative to the list of eight issues described in section 2.1 of this document (Haas 1991). The eight issues ranked in terms of decreasing priority for Saskatchewan were:

- Agricultural soil resources - wind erosion, salinization, reduced fertility
- Surface and groundwater quality - livestock contamination of water
- Water quantity - uneven distribution and availability
- Pollution and waste management - fairly localized
- Wildlife habitat - allocation of costs and benefits, habitat conservation
- Energy - need for alternative sources of energy
- Genetic resources - more of a national issue but concerns for grassland
- Air and climate - more of a national issue

2.2.4 Manitoba

Manitoba's land base includes 5.5 million hectares of cropland and 2.4 million hectares of hay and pasture (Entz 1991). Manitoba's Department of Agriculture has a Land and Water Strategy under which six priorities are listed for each of the soil and water components. For soil these include:

- Soil quality
- Soil moisture management
- Saline soils
- Environment protection and enhancement
- Land use planning
- Conservation and education

For the water component, the key issues include:

- Water quality

- Conservation
- Use and allocation
- Water supply
- Flooding
- Drainage
- Education

Based on involvement with Federal-Provincial processes, including "Growing Together" and a Manitoba public consultation process on Agricultural and Environmental Sustainability, the Province of Manitoba determined that the priority issues were:

- Agricultural soil resources
- Water quantity and surface and groundwater quality

2.2.5 Ontario

1986 Census information indicates that agricultural land in Ontario amounts to approximately 4 million hectares of "improved" land and 1.5 million hectares of unimproved agricultural land (Van den Broek 1991). Approximately 95% of this land is in southern Ontario, with the balance in northern Ontario (op.cit.).

The key land and water degradation problems in Ontario as described by Van den Broek (1991) and ranked in terms of importance by Hill (1986) are:

- Soil erosion - extremely important
- Soil compaction - extremely important
- Organic matter loss - extremely important
- Water quality - very important
- Soil erosion by wind - important
- Wetland loss - important

Soil erosion potential is highest in watersheds which contribute to Lake Erie and Lake Ontario (Van den Broek 1991). These are locations which also support the largest hectares of row crops in the form of corn and soybeans (op. cit.).

Soil compaction is a concern primarily for southern Ontario, where it is estimated to affect 40-50% of the land (op. cit.).

Organic matter loss is an issue not confined to a particular region or soil type but occurs in locations where excessive tillage and soil erosion is prevalent (op. cit.).

Surface and groundwater quality concerns exist primarily in southern Ontario in locations bordering Lake Huron, Lake Erie and Lake Ontario (op. cit.).

Southern Ontario is estimated to have lost 70% of its wetlands, with much of this loss attributable to agricultural activities (Bardecki 1987, Environment Canada 1991, Van den Broek 1991).

Many of Ontario's farm organizations formed a coalition to outline the agricultural community's concerns about environmental issues and the Ontario agri-food industry. These concerns and strategies for addressing them are articulated within a document entitled "Our Farm Environmental Agenda". The key items are not fundamentally different from those described above but they are more explicit and as a result, are listed here:

- Concerns relating to soil
  - Soil erosion
  - Soil structure
  - Organic matter

- Concerns relating to water quality and supply
  - Nitrates
  - Phosphates
  - Biological by-products and wastes
  - Water management

- Air quality concerns
  - Noise
  - Dust and odour
  - Atmospheric greenhouse gas exchange

- Concerns relating to agricultural inputs
  - Pesticides and fertilizers
  - Energy

- Natural resources
  - Wildlife
  - Wetlands
  - Woodlands

2.2.6 Quebec

The chief land degradation issues facing Quebec were summarized by Fox et al. (1986):

- Water erosion
- Wind erosion
- Soil compaction
- Wind erosion (minor issue)

2.2.7 New Brunswick

Monenco (1985) and Fox et al. (1986) summarized the chief land degradation issues facing New Brunswick:

- Water erosion (major issue)
- Acidification
- Soil compaction
- Low organic matter
- Wetland drainage

2.2.8 Nova Scotia

The chief land degradation issues facing Nova Scotia were summarized by Agriculture Canada (1985), Monenco (1985) and Fox et al. (1986):

- Water erosion
- Acidification
- Soil compaction
- Low organic matter

- Wetland drainage

2.2.9 Prince Edward Island

The Province of Prince Edward Island (PEI) recently presented a document to the public regarding a conservation strategy for natural resources and the agricultural sector. This document, entitled "Stewardship and Sustainability" (PEI Department of the Environment 1991) lists the six issues/goals related to this topic:

- Reduce soil erosion
- Maintain and improve water quality
- Reduce solid waste
- Maintain and improve ecological diversity
- Maintain and improve air quality
- Increase public involvement

Monenco (1985) and Fox et al. (1986) listed the land degradation issues facing PEI as:

- Water erosion
- Acidification
- Soil compaction
- Low organic matter
- Wind erosion (minor issue)

2.2.10 Newfoundland

Monenco (1985) and Fox et al. (1986) considered the principal land degradation issues facing Newfoundland to be:

- Water erosion
- Wind erosion
- Acidification

- Low organic matter
- Soil compaction (minor issue)

2.2.11 Summary

A summary of agri-environmental issues was compiled from the literature and the structured interviews undertaken across Canada as part of this study. The key issues identified for each province are illustrated in a matrix (Figure 2.1).

2.3 SPECIFIC ENVIRONMENTAL ASSESSMENT QUESTIONS FOR NISA

In sections 2.1 and 2.2 the principal environmental issues in the Canadian agri-food sector were identified and briefly discussed. In general, the objective of this environmental review of NISA was to assess whether, and to what extent, NISA may be implicated directly or indirectly in those environmental issues.

The desire on the part of policy makers to ensure that the new generation of farm safety net programs would be environmentally more sustainable than the older programs they were replacing, had already led to preliminary attempts to assess the environmental implications of the various new program options under consideration during the design phase. However, these early assessment attempts had been largely qualitative, and were hampered by inadequate information and data. Ultimately, no definitive conclusions were reached prior to introducing GRIP and NISA, although certain features of the new programs were thought to be improvements over the older programs such as the Western Grain Stabilization Program. But the basic concerns remained: How will these new programs influence the production decisions of farmers, and with what environmental consequences for wetlands, soils, wildlife habitat, water quality and air quality?

Through a combination of literature review and structured face-to-face interviews with resource professionals in each province (see Appendix II for listing of individuals interviewed), twelve specific environmental assessment questions were identified. These can be conveniently grouped under eight main headings as follows.

2.3.1 Land Use and Cropping Diversity

Question 1. Does the reduction in income risk afforded by NISA affect producers' decisions regarding which crop(s) to grow, total acreage for specific crops, summerfallow acreage, or total cropped acreage?

Question 2. Does NISA contribute to increased or decreased specialization, and does this affect minor crops?

FIGURE 2.1

ENVIRONMENTAL ISSUES IN THE CANADIAN AGRI-FOOD SECTOR*

ENVIRONMENTAL ISSUE	B.C.	ALTA.	SASK.	MAN.	ONT.	QUE.	NEW BRUNS.	NOVA SCOTIA	PEI	NWFLD
SOIL DEGRADATION										
• wind erosion	√	√	√	√	√		√			√
• water erosion	√	√	√	√	√	√	√	√	√	√
• organic matter loss	√	√	√	√			√	√	√	√
• soil compaction	√				√	√	√	√	√	√
• acidification							√	√	√	√
• contamination					√					
• salinization		√	√	√						
WATER QUALITY/FISH										
• fertilizer contamination	√			√	√	√			√	
• pesticide contamination	√			√	√	√			√	
• animal waste	√	√	√	√	√	√	√	√	√	
• water availability		√	√	√						
• flooding	√			√	√	√	√	√	√	
HABITAT DEGRADATION										
• wetland drainage	√	√	√	√	√	√	√	√	√	
• upland clearing	√	√	√	√						
AIR QUALITY/CLIMATE										
• dust/odour		√	√	√	√					
• greenhouse gas	√	√	√	√	√	√	√	√	√	√
ENERGY										
			√		√					
GENETIC RESOURCES										
			√							

* Derived from review of major documents and structured interviews.

Question 3. Is NISA de-coupled from production?

Land use implications of NISA have been debated by various interest groups. Most of the environmental criticism directed at NISA has been linked to land use, specifically to changes in areal coverage of various crops as well as the intensification and specialization of farming practices.

Shifts in crop mixes favouring one or a few commodities may also result in expansive monocultures, which in turn results in increased soil degradation in the form of organic matter losses and increased erosion (Environment Canada 1991).

Diversification within agriculture is desirable as a means of enhancing environmental sustainability and possibly, economic stability for individual producers. Diversification may take the form of longer rotations incorporating a broader range of crops, or a better balance of cropping and livestock enterprises, both regionally and at the individual farm level (Altieri 1987).

For many years it was believed that farming sectoral productivity, growth and competitiveness could be improved by assisting the sector to specialize, expand and intensify production. The chief impediment standing between producers and the higher short-term economic returns associated with specialization has always been the greater income risk inherent in putting all one's eggs into one basket. Insurance programs are designed to address this impediment to specialization.

Unfortunately, specialization is strongly linked to many of the current resource base and environmental concerns that now confront us. Without insurance programs which promote specialization, the rational response to risk is diversification. Any program that actively reduces income risks without simultaneously promoting more and longer rotations, mixed crop/livestock farming, conservation tillage systems and related environmental protection measures, may contribute to the environmental problems that result from specialization.

Neutrality with respect to producer decisions on what to plant was one of the key criteria for assessing safety nets, according to the Federal-Provincial Safety Net Committee. However, there are concerns that NISA is not neutral. Indeed, some interviewees voiced concerns that NISA discouraged forage production. Interviewees were concerned that, if large expanses of forage crops were converted to grains, oilseeds or specialty crops, it would adversely impact soil quantity and quality, water quality, and ultimately wildlife populations.

2.3.2 Marginal Lands, Wetlands and Wildlife Habitat

Question 4. Do government contributions (subsidies) to NISA accounts distort land use in ways that affect marginal lands, wetlands, wildlife habitat, or contractual set aside lands?

Land use concerns in agriculture generally relate to marginal lands that cannot physically sustain viable annual crop production, either in and of itself or using traditional production techniques. Marginal lands are environmentally sensitive because of their biophysical characteristics as wildlife habitat, wetlands, riparian zones, native prairie and/or highly erodible lands. Marginal lands have consistently been vulnerable to development as a result of economic pressures on producers. For example, as of 1990, over 71% of Canada's wetlands have been drained and 82% of prairie wetland margins have been cleared or cultivated for agricultural expansion (Environment Canada 1991). Agriculture Canada has stated that NISA should not encourage the breaking up of new land at the expense of wetlands, native prairie and other wildlife habitat areas. Moreover, the Federal-Provincial Safety Net Committee stated, "programs should not encourage cereal production on fragile lands." This was one of the criteria for evaluating safety net programs that the Safety Net Committee developed.

In its present format, NISA does not appear to provide any specific disincentives to undesirable modifications in land use, particularly in environmentally sensitive areas. But the critical question related to land use, "How does NISA influence the use of marginal lands?" remains to be answered.

Due to the costs of converting wetlands and other wildlife habitat such as woodlots to annual crop production, the economic incentives to continue this trend will depend directly on prices farmers receive from the marketplace and on the magnitude of ongoing financial support from governments to maintain net incomes in crop production.

2.3.3 Impacts on Livestock Sector and Diversification

Question 5. Are there any features of NISA as currently implemented that affect cattle production either positively or negatively, and with what environmental consequences?

Question 6. Does the failure to cover forages or to offer whole farm coverage affect the livestock sector, or influence the level of diversification?

The Canadian Cattlemen's Association is one of many groups and individuals to criticize NISA for failing to cover forages. Both for annual and perennial forage crops, the failure to provide coverage implies a failure to achieve neutrality with respect to land use. Consequences could include disincentives to integrate crop and livestock production and in particular to grow forages which provide good protection against soil degradation (Dawson and Elofson 1991).

Interviewees in several provinces voiced concerns over the failure of NISA to cover forages. Several interviewees pointed out that, in addition to providing better protection from soil degradation than most NISA-eligible crops, annual and perennial crops also provide better wildlife habitat. Moreover, several interviewees from the Prairie Provinces noted that

forages in their region are usually associated with marginal lands [i.e., wetlands and Canada Land Inventory (CLI) Class 5 and 6 lands]; hence, the conversion of these areas to NISA-eligible crops would exacerbate the aforementioned concerns.

2.3.4 Cultural Practices and Innovation

Question 7. Do the terms and conditions or any other contractual features of NISA affect producers' decisions regarding the choice of production system or technology?

Question 8. Are organic producers or farmers who use innovative or alternative production systems eligible to participate in NISA?

Question 9. What are the environmental consequences of any identified incentives or disincentives to the adoption of conservation practices under NISA?

The Safety Net Committee stated, "...programs should neither encourage inefficient cultural practices nor those which may harm the environment by degrading the resource base." When producers are directly or indirectly penalized under an insurance program because of their efforts to conserve resources or protect the environment (Ducks Unlimited 1991), then it can be argued that there is a defect in the program. In this context it is worth recalling that FIPA -- the enabling legislation for GRIP and NISA -- states, as one of its fundamental principles, that programs should encourage long term economic and environmental sustainability (emphasis added).

2.3.5 Soils

Question 10. Do distortions in land use under NISA result in increased or decreased soil degradation?

By introducing a new set of incentives and disincentives NISA may adversely affect soil conservation efforts of farmers. This is another aspect of resource neutrality that overlaps with the previous section on land use practices. The critical question is, does NISA reward efforts to conserve soils and protect the environment, or does it act as a barrier to investments in soil conservation?

2.3.6 Whole Farm Coverage

Question 11. Does the failure to cover all farm production enterprises act as a disincentive to diversification and environmental degradation or would whole farm coverage improve the environmental performance of NISA?

2.3.7 Other Evaluation Questions

Question 12. In light of the environmental assessment findings, what specific changes and amendments to NISA are recommended in order to make the program more environmentally sustainable?

2.4 SUMMARY

Just as the environmental problems in the Canadian agri-food sector varied from province to province, so too do the assessment issues. This is a consequence of the unique environmental conditions in each province across Canada.

Issues related to NISA which were prevalent across the country are summarized below.

LAND USE

- The potential for adverse crop selection leading to concerns such as monocultures and reduction in crop rotations which in turn can contribute to problems such as soil erosion.
- The potential for NISA encouraging or deterring the use of conservation farming practices.
- Concerns that exclusion of forages from NISA may deter mixed-farming enterprises and degrade existing wildlife habitats on agrarian settings.

WILDLIFE HABITAT

- NISA might discourage forage crops and pasture lands, thereby adversely impacting wildlife species that are dependent on these areas to meet all or a portion of their life-history requirements.

The goal of the assessment was to address the assessment issues and questions identified in this chapter. In the next chapter, the analytical framework for addressing these issues and questions is presented.

3.0 ANALYTICAL FRAMEWORK FOR THE ASSESSMENT

3.1 INTRODUCTION

The primary objectives of the environmental review of NISA were to: (1) evaluate if the program has had impacts (positive or negative) on the biophysical environment and (2) recommend future actions to minimize any negative impacts that are discovered. In particular, our goal was to address the environmental assessment issues and questions identified in chapter 2. In order to do this, an analytical framework was used. This framework comprised five components or lines of investigation as follows:

i) Conceptual or theoretical examination of incentives under NISA;

ii) Descriptive analyses of information gathered through literature review, written submissions, survey of program participants, and other means;

iii) Simulation studies of soil degradation and non-point source pollution using the EPIC model;

iv) Synthesis, integration and rationalization of the findings from each of the above components of the assessment, leading to conclusions;

v) Examination of mitigation measures, and development of recommendations.

A conceptual illustration of information flow through the assessment process is illustrated in Figure 3.1. Essentially, primary information and data were acquired directly from farmers who were participating in the program, by means of a mail survey. Concurrent to the collection of primary data for analyses, a conceptual or theoretical assessment of program influences on farmers' decisions was undertaken. Unlike the concurrent assessment of GRIP, econometric models were not formulated with respect to whether the 1991 land and input usage represented a significant departure from previous years, because the application form detailing the terms of conditions for NISA participation was not available until the latter part of July 1991. Moreover, initial scoping and theoretical analyses did not elucidate how secondary information and data could be used in a meaningful way to assess the impacts of NISA.

The primary level of stratification for the environmental assessment was the major soil regions identified in Agriculture Canada's publication "Soils of Canada." Soils within these various regions have different susceptibilities to wind and water erosion, soil organic matter depletion, water quality degradation, salinization, and have marginal to high capabilities for agriculture and wildlife. Hence, stratification by soil region, hereafter referred to as soil zones, enabled us to assess the environmental and economic impacts of NISA on these biologically and agriculturally distinct regions within each province.

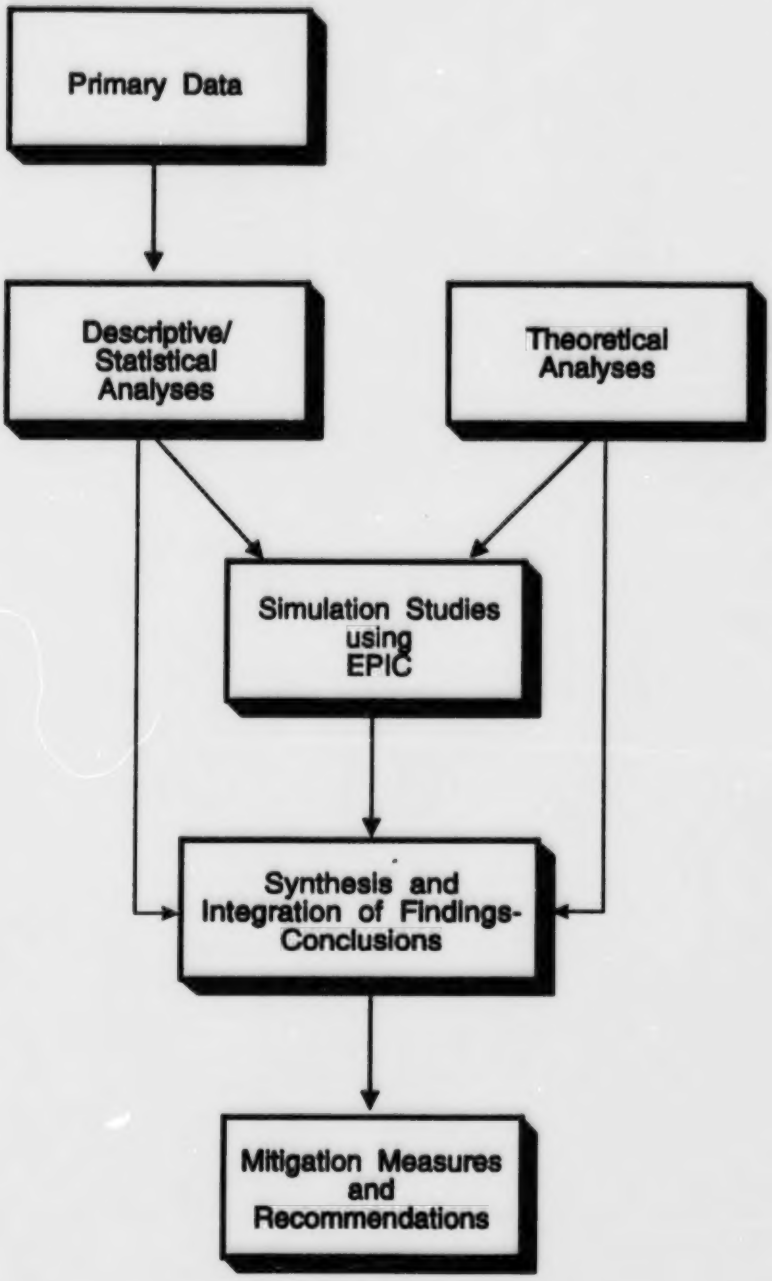

FIGURE 3.1 ENVIRONMENTAL ASSESSMENT FRAMEWORK

Within each soil zone, primary data were analyzed to determine if land/input use practices changed as a result of NISA (Figure 3.1). If the program was deemed responsible for land/input use changes, each change was assessed independently for its effect on the environment.

Characterizing identified impacts relied upon a set of impact definitions that were developed by the study team. These definitions were derived from impact assessment literature (e.g., Shopley and Fuggle 1984, Conover et al. 1985, CEARC 1988), coupled with the investigators' experience with other current impact assessments.

Definitions of impacts frequently involve the implications for biological populations (e.g., Conover et al. 1985) but these are inappropriate for assessing abiotic components of the environment (e.g., air quality, water quality, soil erosion). Therefore, customized definitions were required for this study. Given the diversity of environmental issues to be addressed and the fact that quantitative and qualitative methods were applied, a strong reliance was placed upon professional judgement in formulating these definitions. This is a common characteristic of environmental prediction approaches.

These definitions were established *a priori* (i.e., before the impact assessment occurred).

Scope

The scope of an impact relates to the geographical extent of that impact. For the purposes of this assessment, impact scope was confined to **Provincial** (an individual province) or **National** (the majority of or all provinces).

Duration

Impact duration relates to the period of time that the impact to the affected resource is detectable. For the purposes of this assessment, **Short-Term** refers to impacts which are manifested during a period of less than 10 years. **Long-Term** impacts are those that extend beyond 10 years and which may affect several generations.

Magnitude

Impact magnitude refers to the proportion of a population or resource affected by that impact. Duration of the impact also can influence magnitude.

A **Major** impact is defined as one that affects a resource base in a manner that jeopardizes the sustainability of that resource. In other words, the impact causes a decline or degradation of the resource beyond which natural events would not return that resource to its former level within several decades or generations (for abiotic environmental components 1 generation = 1 year). Major impacts can be manifested in the short and long-term. These impacts are readily detectable, have great ecological effects and are likely to generate

intense public interest. Negative impacts are difficult to manage and also may be difficult to mitigate. Beyond the impact to the immediately affected resource, a major impact could occur if it compromises the resource user. Thus, for example, soil erosion which affects topsoil accumulation may also have adverse effects on the resource users' (farmer) ability to produce crops.

A **Moderate** impact affects the quality, abundance and/or distribution of the resource or users of that resource for one or more generations. Negative impacts may not compromise the long-term sustainability of the resource. Moderate impacts are detectable to the trained observer and may generate public interest. Negative impacts may be mitigated for fairly readily.

A **Minor** impact is one that affects only a small proportion of a resource. A minor impact is also one that will not adversely affect the long-term integrity of the resource. It is also unlikely to generate wide-spread public interest. Minor impacts are detectable only to the trained observer. Negative impacts can be prevented and mitigation measures, where required, should be readily attainable.

A **Negligible** impact is one that is either not detectable or for which a very small proportion of the resource is affected. At this level of detection, the changes to biota could be readily attributed to natural, random fluctuations in the environment.

The net effects of NISA were calculated for each province and were examined and overall environmental impact evaluations of NISA were determined. In some instances, e.g., wetland loss due to NISA, the net effect of the program on a particular environmental component might be deemed unacceptable. Hence, even if all net effects on the other environmental components are neutral, or even positive, the overall environmental impact would still be deemed negative. If the program was deemed to have negative environmental impacts, mitigative measures were recommended to alleviate the impacts.

3.2 DATA ACQUISITION

3.2.1 Primary Data

A mail survey was developed to assemble primary data on land and input use practices of NISA participants before and after enrolment in the program. The mail survey asked program participants about their land and input uses in 1990 and 1992 (i.e., pre-NISA and post-NISA) in all provinces surveyed (Appendix III). If their land/input uses changed between the two time periods, the farmers were asked what influence NISA had on the changes.

All provinces participating in the NISA programs were sampled, except Quebec. As was discussed in the Introduction, the fundamental unit of stratification within each province was

the major soil regions identified in Agriculture Canada's publication "Soils of Canada." Soil zone strata used in each participating province were as follows:

British Columbia:

- C2 Gray Luvisol (Gray Wooded)

Alberta:

- A1 Brown Chernozemic
- A2 Dark Brown Chernozemic
- A3 Black Chernozemic
- Solonetzic Soils (B1, B2, and B4 pooled)
- C2 Gray Luvisol (Gray Wooded)

Saskatchewan:

- A1 Brown Chernozemic
- A2 Dark Brown Chernozemic
- A3 Black Chernozemic
- C2 Gray Luvisol (Gray Wooded)

Manitoba:

- A3 Black Chernozemic
- A4 Dark Gray Chernozemic
- C2 Gray Luvisol (Gray Wooded)

Ontario:

- C1 Gray Brown Luvisol
- E1 Melanic Brunisol

Atlantic Provinces Combined*:

- Random sample of program participants

*Note: due to similar soil structures and the relatively small enrolment of Atlantic Province farmers in GRIP and NISA, these provinces were pooled. It was believed that the majority of these participants were in the C2 and D2 soil zones.

Within each province, 600 farmers were sampled per soil zone stratum. In each province/region, farmers from 2 distinct groups were sampled per soil zone: those enrolled in both GRIP and NISA programs (n=450) and those enrolled in NISA but not GRIP

(n=150). Sample frames for the 2 groups were then created by cross-referencing the GRIP and NISA data bases supplied by provincial and federal agencies. Within some soil zones (within certain provinces) all eligible farmers were sampled before the target number of 150 or 450 was reached. Consequently, the following number of farmers were sampled from each province:

	GRIP/NISA	NISA only	TOTAL
• British Columbia:	n = 235	n = 365	n = 600
• Alberta:	n = 2 250	n = 750	n = 3 000
• Saskatchewan:	n = 1 800	n = 600	n = 2 400
• Manitoba:	n = 1 316	n = 484	n = 1 800
• Ontario:	n = 900	n = 300	n = 1 200
• Atlantic Provinces:	n = 380	n = 217	n = 597
Total Sample Size	n = 6 881	n = 2716	n = 9 597

The sample size of at least 150 individuals per Soil Stratum x Farmer-group x Province category was chosen as a suitable compromise between statistical and budgetary constraints: large sample sizes are necessary to ensure statistical precision, yet budgetary realities placed a ceiling on sample sizes.

The mail survey was designed to obtain information on land use and input use practices of Canadian farmers during the 1990 and 1992 farming seasons. These time periods were chosen to obtain data on farming practices before and after GRIP/NISA program initiation. Because the programs were initiated in the spring of 1991, we believed that many farmers would not fully understand the programs and thereby not have opportunity to alter their farming practices during that farming season. Thus, for the NISA assessment, the 1991 farming season was omitted for all provinces.

The questionnaires and cover letters were reviewed, revised and eventually approved by Agriculture Canada. A NISA questionnaire was developed for those participating in the NISA program but not GRIP and a GRIP/NISA questionnaire was developed for the participants of both programs.

The mail survey was designed and administered following the Total Design Method (Dillman 1978). All questionnaires were individually marked with large identification numbers in the upper left-hand corner of the inside cover. The identification number facilitated deletion of respondents from subsequent mailings, indicated their province of residence, the soil classification of their farm, and denoted whether they were enrolled in NISA only, or GRIP and NISA.

The mail survey utilized 4 separate personalized mailings over a 10 week period (Table 3.1). All mailings were dispatched through first-class mail. The initial mailing contained a questionnaire, personalized cover letter explaining the purpose of the survey, and a postage-paid return envelope. The second mailing, dispatched to all farmers 1 week after the initial

TABLE 3.1

MAIL SURVEY ACTIVITY AND MAILING DATE OF ACTIVITY

ACTIVITY		DATE
First Mailing:	Cover letter and questionnaire sent to everyone in the survey via first class mail	16 November 1992
Second Mailing:	Reminder/thank you postcard sent first class to everyone	23 November 1992
Third Mailing:	New cover letter and another copy of questionnaire sent first class to nonrespondents	7-9 December 1992
Fourth Mailing:	New cover letter and another copy of questionnaire sent first class to nonrespondents	18-22 January 1993

mailing, consisted of a postcard reminder/thank you. The third mailing, dispatched to all nonrespondents 2 weeks after the second mailing, contained a new personalized cover letter, another copy of the questionnaire, and another postage-paid return envelope. The final mailing, dispatched to all nonrespondents 6 weeks after the third mailing, contained a new personalized cover letter, another copy of the questionnaire, and another postage-paid return envelope.

3.2.2 Secondary Data

As stated above, the initial scoping and theoretical analyses did not elucidate how secondary information and data could be used in a meaningful way to assess the impacts of NISA. Hence, secondary data were not used in our assessment of NISA.

3.3 LAND/INPUT USE CHANGE

Land and input use capture most of the linkages to on-farm and off-farm environmental impacts of farming activities in Canada. Hence, the influence of NISA on land and input use practices was the primary focus of this environmental assessment. As discussed above, the mail survey provided data on land and input use practices of NISA participants before and after enrolment in the respective programs and allowed us to determine what influence, if any, the program had on land/input use.

It is important to note that the environmental assessment was contingent upon clearly identifying land/input use changes attributable to NISA. Hence, prior to proceeding with the environmental assessment, one or more of the following null hypotheses had to be rejected:

H_1: Land use practices of NISA participants did not change as a result of their enrolment in the program.

H_2: Input use practices of NISA participants did not change as a result of their enrolment in the program.

Descriptive and statistical analyses were used to test these hypotheses.

The following sections of chapter 3 describe each component of the assessment framework, but do not incorporate any findings or results of the assessment (which are presented in subsequent chapters).

3.4 THEORETICAL ASSESSMENT

The first component of the assessment framework consisted of an examination of the details of the program, and a conceptual or theoretical assessment of the influences the program was likely to have on farmers' decisions about crop selection and input use.

3.5 DESCRIPTIVE ASSESSMENT

The second approach to answering the assessment questions was through descriptive summaries of both NISA-related literature and information gathered through interviews, mail survey and written submissions. This component incorporated detailed summaries of written briefs submitted by interested individuals and organizations, a detailed analysis of the descriptive information obtained through interviews of resource professionals in each province, and some of the descriptive information gathered in the direct survey of a random sample of program participants in each province (except Quebec). The intention here was to provide a clear picture of perceptions of farmers and others regarding possible linkages between NISA and the environment.

Fiscal and temporal constraints rendered a detailed assessment of the effect of NISA on all environmental components unfeasible. Therefore, it was decided that the environmental assessment would focus on 2 major environmental components: soils and wildlife habitat.

Inasmuch as the major thrust of the environmental assessment was on the effects of NISA-induced land and input use changes on soils and wildlife habitat, the survey questionnaire was structured accordingly. Hence, the soils and the wildlife assessments were largely driven by information obtained in the mail survey. The soils assessment was driven by simulation studies, whereas the wildlife assessment relied on information derived through a descriptive assessment.

The environmental acceptability of any land/input use changes brought about by NISA was judged based upon predetermined environmental criteria. These criteria were region or soil zone specific. The wildlife criteria are discussed in depth below.

3.5.1 Wildlife

Today, wildlife professionals recognize the need to approach wildlife management from a holistic perspective. Species, including threatened or endangered ones, can only be preserved if their habitats are preserved. In essence, healthy habitats are necessary for healthy wildlife communities. However, the quantity and quality of wildlife habitat are declining in Canada. Lost or altered habitats, primarily in southern Canada, have reduced the abundance, diversity, and distribution of many indigenous species (Wildlife Minister's Council of Canada 1990). Thus, wildlife planners are attempting to ensure species diversity by developing habitat preservation goals for specific communities.

The basic tenet of wildlife management states that without habitat, there is no wildlife. Therefore, we focused our wildlife assessment on the effects of NISA on the quality and quantity of wildlife habitat within each soil zone. A habitat-based assessment was necessary because fiscal and temporal constraints rendered species-specific assessments for individual soil zones impractical.

A Wildlife Policy for Canada, the national policy developed to provide a framework for federal, provincial, territorial and nongovernmental policies and programs that affect wildlife, states, "Governmental policies and legislation on resources and the environment and strategies for sustainable development should provide for conservation of wildlife and its habitats, and should ensure that all uses of resources are sustainable (Wildlife Minister's Council of Canada 1990:11)." The policy goes on to state (page 13), "*New technologies, policies, and laws--especially major macroeconomic, finance, and sectoral policies and laws that are likely to result in significant impacts on the environment--should also be assessed for their impacts on wildlife and biodiversity. Based on this analysis, governments should eliminate measures that favour overexploitation of biological resources or destruction of habitats.*" Therefore, according to this policy, NISA should not encourage/influence the destruction of habitats, and a zero tolerance for habitat destruction is implied.

A Wildlife Policy for Canada defined wildlife as "all wild organisms and their habitats..." (Wildlife Minister's Council of Canada 1990). Our wildlife assessment focused on habitats, with the realization that all wild organisms are integral components of habitat.

Wildlife habitat can be divided into three broad habitat types: wetland, upland, and riparian (i.e., streamside). Hence, the impact of NISA on these three habitat types was assessed within each soil zone. The questionnaire quantified if NISA had caused the decline in any of these habitat types, and if so, at what magnitude. Then, based on habitat-specific assessment criteria (i.e., tolerance levels) established "*a priori*," an environmental impact evaluation was undertaken. Assessment criteria for the respective habitat types are presented below.

Wetland Habitat

Agriculture has been associated with the loss of 85% of Canada's wetlands (Wildlife Habitat Canada 1991). More specifically, agricultural development has been the major force in eliminating 68% of the wetlands in southern Ontario and 71% of the wetlands in the Prairie Provinces (Environment Canada 1986). In 1990, 30% of the existing wetland basins and 82% of the wetland margins in the Prairie Provinces were adversely impacted by farming activities such as clearing, drainage and cultivation (Caswell 1990). The World Wildlife Fund of Canada concluded in 1988 that the protection of the remaining wetlands in the Canadian Prairies was vitally important. However, *The Federal Policy on Wetland Conservation* (Government of Canada 1991*a*) recognises the value and importance of all wetlands in Canada, not just those located in the Prairie Provinces. Indeed, Wildlife Habitat Canada (1991:78) concluded, "Since wetlands are some of Canada's biologically richest habitats, they must be maintained across all landscapes."

The Federal Policy on Wetland Conservation outlines seven strategies for the use and management of wetlands in Canada. Strategy number two states, "The Federal Government will develop exemplary practices in support of wetland conservation and sustainable wetland use to be incorporated in the design and implementation of federal programs..." The Policy

goes on to state that all federal departments should commit to the goal of no net loss of wetland function on federal land and waters and in areas affected by the implementation of federal programs where the continuing loss or degradation of wetlands has reached critical levels. The preceding paragraph leaves little doubt that wetland losses in agricultural landscapes across Canada have reached critical levels. Therefore, we invoked a zero tolerance level in assessing the impact of NISA on wetland habitats in all soil strata. Hence, if NISA caused loss of wetland habitat or function at any scale, the environmental impact was deemed negative and mitigation measures were required.

Upland Habitat

Conservationists across Canada agree that upland wildlife habitat must be preserved and enhanced within farmlands. For example, *The Status of Wildlife Habitat in Canada* (Wildlife Habitat Canada 1991) stated, "The farms of tomorrow should contain more, well connected areas of natural vegetation." Moreover, *The State of Canada's Environment* (Government of Canada 1991*b*) stated, "Wildlife habitat within agricultural areas must be conserved and enhanced to sustain a wide diversity of plant and animal species." Members of the agricultural sector also appreciate the need to conserve existing upland habitats within the agricultural landscape. For example, Ontario farmers recently published *Our Farm Environmental Agenda* (Ontario 1992), in which they recognized the need to preserve existing woodlots on the family farm. However, unlike wetland habitat, we could find no federal policy that specifically calls for the preservation of upland habitats on private lands. Nonetheless, *A Wildlife Policy for Canada* clearly states that governments should eliminate or modify policies that favour destruction of habitats. Inasmuch as upland habitats are indeed habitats, the wildlife policy can be interpreted to mean NISA should not encourage destruction of upland habitats in any region of the country.

Upland Areas of Special Concern

The Canadian prairie ecosystems (grasslands and parklands) are located in the southern portions of Alberta, Saskatchewan, and Manitoba. These areas have been so radically transformed by human activity that they have become one of the most endangered natural regions in Canada. In fact, by the early 1980's, 70% of this region was under cultivation (Rowe and Coupland 1984). Today, little native prairie remains in a natural state, and what little remains is rapidly disappearing (World Wildlife Fund Canada 1989). For example, less than 1% of the original tall-grass prairie, 18% of the shortgrass prairie, 24% of the mixed grass prairie, and 25% of the aspen parkland remains (Gauthier and Henry 1989). Therefore, these habitats and their associated wildlife communities are of special concern (Wildlife Habitat Canada 1991).

Several organizations have stated that the loss of habitat is the most critical issue facing prairie wildlife today (e.g., Gauthier and Henry 1989). Moreover, (1) relative to its area, a disproportionate number of threatened and endangered wildlife species live in the prairie ecosystems (Burnett et al. 1989), (2) the multinational North American Waterfowl

Management Plan calls for the maintenance and enhancement of upland waterfowl nesting habitat within the Prairie Provinces; and (3) the Prairie Conservation Action Plan (World Wildlife Fund Canada 1989) calls for the conservation of all existing native prairie and states that all federal and provincial governments should revise their policies and legislation to encourage conservation of habitat. Hence, it seems protection of the remaining Prairie habitats is vitally important to Canada's wildlife.

Based on this compelling evidence for the need to conserve remaining natural habitats within the Prairie Provinces, we invoked a zero tolerance level for NISA-related upland habitat loss within the prairie soil strata. Hence, if NISA caused upland habitat loss at any scale within the Prairies, the environmental impact was deemed negative and mitigation measures were required.

Outside the prairie soil strata, e.g., in British Columbia, Ontario, and the Atlantic Provinces, private and governmental conservationists were contacted to establish tolerance levels (if they existed) for upland habitat loss. None of the individuals that were contacted in these provinces expressed concern over upland habitat loss in agrarian settings. Hence, no "*a priori*" tolerance levels were established for these areas.

Riparian Habitat

Riparian zones are bands of vegetation associated with stream/river banks. Plants within riparian zones generally require greater soil moistures than would be found in adjacent uplands. Hence, riparian zones usually create well-defined habitat zones within drier surrounding areas. While riparian zones usually include a minor proportion of the overall landscape, they are more productive in terms of plant and animal biomass than the overall landscape and are a critical source of biotic diversity within the ecoregion (Thomas et al. 1979). Johnson et al. (1977) concluded riparian habitats were the most productive and possibly the most sensitive habitats in North America.

By definition, riparian zones contain water. Thus, food and cover are usually the limiting elements to terrestrial wildlife species within riparian zones. Riparian vegetation provides escape, hiding, and thermal cover; nesting sites (in living and dead vegetation); and food in the form of bark, branches, leaves, berries, and seeds. Animals that eat riparian vegetation (herbivores such as insects, rodents, and ungulates) may in turn be eaten by carnivores such as other insects, amphibians, birds, weasels, and coyotes. Thus, riparian vegetation comprises the primary food and cover sources supporting the terrestrial wildlife component of the ecosystem. As vegetational species composition, species diversity, and vertical and horizontal structure increase, so too do wildlife species diversities and numbers (Ricklefs 1979).

In addition to providing habitat for wildlife species that spend most of their lives in or near the zone, riparian zones often provide wooded connectors through and between open habitats, thus supplying migration routes for many terrestrial species of wildlife that

otherwise might not spend much time in the zone (Risser and Harris 1989). Additionally, when riparian habitats are adversely impacted, not only are riparian wildlife affected, but wildlife in the adjacent upland habitats are also negatively affected. Hence, where present, riparian zones are a critical component of the larger ecoregion (Johnson and Jones 1977).

The State of Canada's Environment (Government of Canada 1991*b*) stated that riparian habitats within the Prairies are threatened. Inasmuch as all riparian zones within the Prairies are integral components of the prairie ecosystems, they should also receive the level of protection afforded to the upland areas discussed above. Therefore, within the Prairie soil zones, a zero tolerance for riparian habitat loss was invoked for the environmental assessment. If NISA caused riparian habitat loss at any scale within the Prairies, the environmental impact was deemed negative and mitigation measures were required.

The Status of Wildlife Habitat in Canada (Wildlife Habitat Canada 1991) concluded that regulations for the conservation of wetlands should also include protection of all riparian zones in Canada. However, we could find no federal policy that specifically called for the protection of riparian zones. Therefore, outside the Prairie soil strata, e.g., in British Columbia, Ontario, and the Atlantic Provinces, private and governmental conservationists were contacted to establish tolerance levels (if they existed) for riparian habitat loss. None of the individuals that were contacted in these provinces expressed concern over riparian habitat loss in agrarian settings. Hence, no "*a priori*" tolerance levels were established for these areas.

3.6 SIMULATION STUDIES USING EPIC

The objective of this assessment was to determine whether potential changes in soil productivity and nonpoint source pollution (NPSP) risk resulting from changes in farming practices as a consequence of NISA existed. To aid in the assessment, the computer simulation model EPIC (Erosion-Productivity Impact Calculator) was applied to the 17 reporting areas identified in Section 3.2.1. EPIC consisted of: (a) physically based components for simulating erosion (wind and water), plant growth, and related processes; and (b) economic components both for assessing the cost of erosion and for determining optimal management strategies. The model was designed to aid in decision-making, ranging in scope from farm-level to national-level decisions and is capable of examining drainage, irrigation, water yield, erosion control, weather, fertilizer and lime applications, pest control, planting dates, tillage, and crop residue management (Sharpley and Williams 1990). The model has been applied extensively in the United States as well as in France (Cabalguenne et al. 1990) and in Alberta from a model evaluation perspective (Izaurralde et al. 1992). It has also been applied to policy evaluation (Lerohl 1991). While the model has extensive capabilities, our focus was on soil erosion (wind and water) and soil quality (organic content), and the related on-farm economic consequences of various soil degradation scenarios.

The EPIC Simulations

The use of EPIC for the assessment of the environmental impacts of policy and programming in the context of sustainable agriculture was fully warranted. In fact, we would argue that it is at present one of the few legitimate tools for such assessment. The alternative was to estimate environmental impacts in terms of rates of eroded soil thickness, or some other measure of immediate environmental degradation such as destruction of wetland habitat or loss of biodiversity, without any reference to the ecosystem's resiliency. In the case of soil erosion rates, "tolerable rates of soil erosion", or *T-values*, have been developed. These values are meant to represent the rate of topsoil (Ah horizon) regeneration, and thus indirectly, the rate at which this topsoil can be removed through erosion without adversely affecting soil productivity. This approach to the assessment of the impact of soil erosion on soil productivity is unreliable in the sense that the accuracy of T-values cannot be tested scientifically. That is, because of the geological time-frames involved, validation and calibration data for models of topsoil regeneration cannot be obtained directly. This makes the verification of the T-value hypothesis impossible. On the other hand, the impact of topsoil removal on soil productivity can be modeled and, more importantly, simulated through the physical removal of regular increments of topsoil in controlled field experiments. This allowed for the testing of modelling hypotheses and the ultimate development of a valid analytical, descriptive and predictive tool. This was the rationale for the development and use of EPIC.

EPIC can generate estimates of soil productivity and NPSP risk estimates such as crop and biomass yield, and nutrient discharges through surface runoff and percolation in response to eroded soil thickness over time for various land uses and farming systems. If these response curves indicate that soil productivity and NPSP can be maintained beyond a set simulation period, 400 simulation years for instance, it can be inferred that the particular farming-system or land use is not an immediate threat to sustained soil productivity. If not, then we would recommend that further increases in soil erosion be prevented if sustainable agriculture is to be assured in that reporting area.

EPIC is essentially designed to simulate the long-term response of soil productivity to soil erosion at the field or quarter section level. Our use of the model, to infer cumulative regional impacts over millions of hectares, was thus subject to qualification. The cumulative impacts that we reported were not regional averages but rather average impacts on representative farms and soils under prevalent land uses and farming systems in that reporting area. The reported environmental impacts were weighted averages, taking into consideration both the change in the areal extent of prevalent land use scenarios and the long-term simulated impact of these scenarios on eroded soil thickness.

As an indicator of the long-term impacts of these rates of erosion on soil productivity and NPSP abatement, we simulated their impacts over a 400 simulation year period. This was equivalent to 200 iterations of the EPIC datasets describing any one, 2-year rotations. If the EPIC-generated rates of erosion did not demonstrate in that simulation period an ability to

destroy the inherent soil productivity and NPSP buffering capacity, then we inferred that they do not represent an immediate threat to sustainable agriculture and that increases in soil erosion rates, attributable to GRIP or NISA for instance, could be endured.

Data Requirements

A summary of the data necessary for the construction of the EPIC data sets in each of the 17 reporting areas is presented in Figure 3.2. Representative soil series were obtained from the Soil Landscape of Canada extended legend. These soil series were the link between the soil zones (SOC) and the soil landscape polygons (SLC) soil horizon (layer) information we needed to run EPIC. Figure 3.2 describes the overall approach to the construction of the EPIC datasets. The 17 reporting areas represent the soil development categories in each province or area. SLF soil data, reported on the basis of soil series, were averaged over each reporting area using dBASE IV.

The EPIC dataset information for the 17 reporting areas was obtained from a variety of sources. Weather and wind data were determined from mean climate normal (1951-1980; Environment Canada) collected at representative sites within each reporting area. Soil horizon information was averaged over the representative soil series. Areal averages in this case were deemed necessary because of the micro-relief and micro-climate of soil series and catenas. Management scenarios were devised according to recommended farm practices and not to actual fertilizer, pesticide and crop mix usage.

Topographic landscape information was used to derive runoff which included slope length, slope aspect and drainage class. All three of these were estimated from descriptions of local and regional landforms provided by the extended legend of the Soil Landscapes of Canada classification.

Estimation of Environmental Impacts

The Seven Prevalent Land Uses and Farming-Systems

To obtain the EPIC-generated rates of soil erosion, we had to construct a number of datasets representative of the prevalent land uses and farming systems in the 17 reporting areas. Based on the survey results, we were capable of identifying seven such land uses which encompassed most of the agricultural activity in these areas. These included:

50/50 cultivated summerfallow/cereal cropping in the Prairies. This farming system is considered conventional and its use is widespread. Environmental impacts associated with this scenario are considered negative to the extent that they contribute to increased wind and water induced soil erosion in the Prairie Provinces and increased water erosion of soil and NPSP in the sub-humid regions of the country.

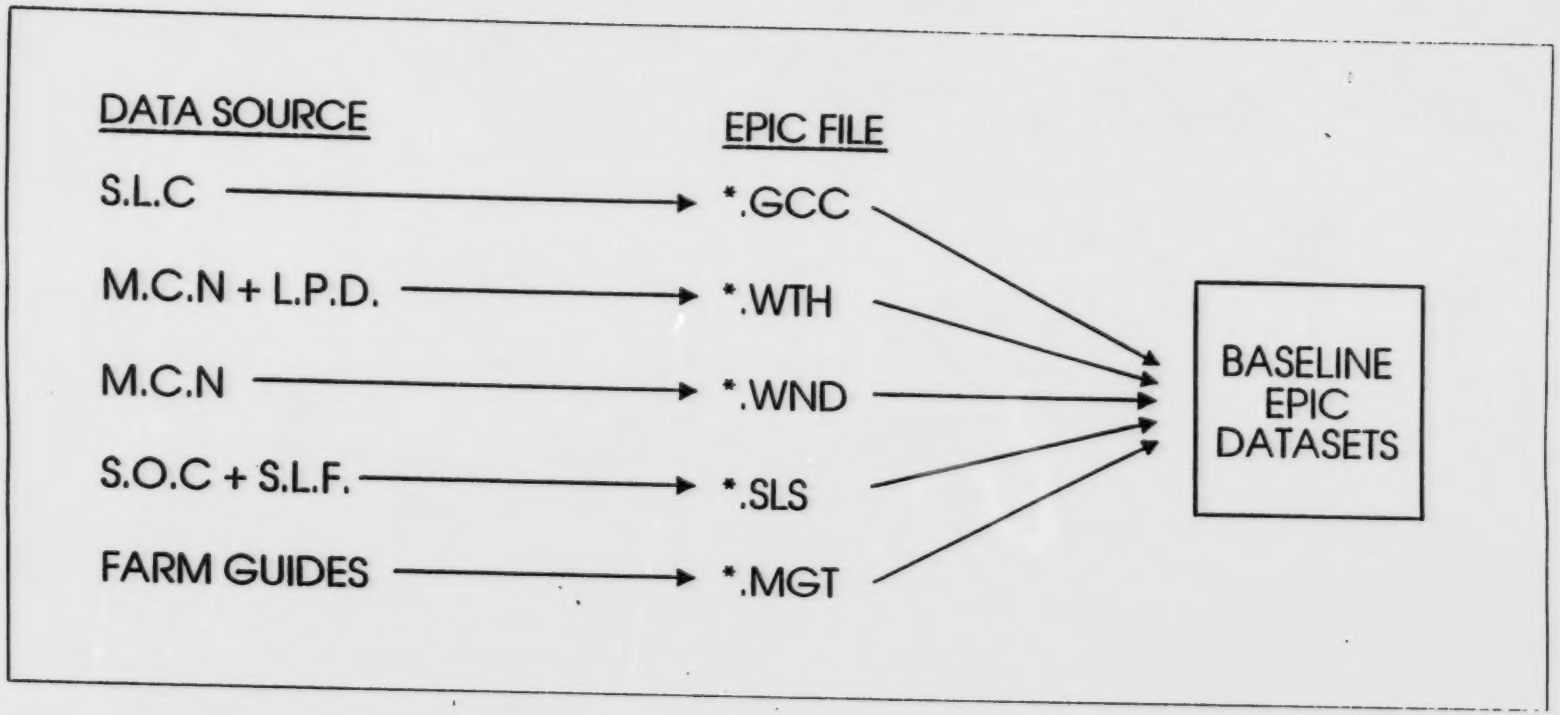

FIGURE 3.2 DATA SOURCES USED TO CONSTRUCT THE BASELINE EPIC DATASETS

SOC: Soils of Canada/Agriculture Canada
MCN: Mean Climate Normal/Environment Canada
LPD: Land Potential Database/Agriculture Canada/CLBRR
SLC: Soil Landscape of Canda/Agriculture Canada/CLBRR
SLF: Soil Layer File/Agriculture Canada/CLBRR

Continuous cropping of cereals and corn. The impact of cultivated summerfallow can also be altered by a shift to continuous cropping of cereals. The prevalence of this land use can be seen as inversely proportional to the prevalence of the previous land use. Because of the continued presence of stubble, the incidence of water and wind-induced soil erosion is reduced and the sustainability of cropping is increased. Continuous cropping of corn, however, is likely to have negative consequences on soil productivity and NPSP risk.

Chemfallow of wheat in the Prairies. As an intermediate alternative to cultivated summerfallow and zerotillage, chemfallow is a means of increasing the sustainability of cropping in the Prairie Provinces. Though it is less risky agronomically than continuous cropping (i.e., the risk of crop failure due to inadequate soil moisture is less), its "chemical dependency" (for weed control) is a source of NPSP risk.

Zerotillage of wheat in the Prairies and the Atlantic Provinces, and zerotillage of corn in Ontario. Zerotillage has the potential to increase the soil organic content of the soil, as well as to reduce the severity of water and wind-induced soil erosion. Because of its greater dependency on chemical weed control and increased fertilizer requirements, zerotillage also can increase agricultural NPSP risk.

Perennial Forages. Perennial forages include alfalfa and clovers grown and mechanically harvested for cattle feed. The rates of soil erosion under such a land use is substantially less than under annual cropping. Perennial forages are also considered a nitrogen benefit to the soil. Perennial here refers to crops lasting more than 2 or 3 years. The plow-down year, though it involves cultivation and soil disturbance, can be seen as a form of green-manuring.

Pasture. Pasture here includes improved, seeded pasture, as opposed to unimproved pasture or range. Conceptually, pasture land here encompasses Permanent Cover Program (PCP) land, that is, marginal land which would otherwise be under annual cultivation.

Rangeland. Rangeland here includes both grazed and ungrazed grassland as well as woodlands and shrub accessible to cattle. Unfortunately, this category is an aggregate of upland woodland and shrub and riparian woodland and shrub. The grazing of riparian areas being of far greater environmental consequence than the grazing of upland areas.

These land uses were not only prevalent but were also representative of the land use decision that the average farmer was faced with. When choosing to remove land from cultivated summerfallow, a farmer was most likely to opt for continuous cropping of cereals, zerotillage or chemfallow. It should be noted that the continuous cropping of cereals in the Prairie Provinces was more likely to be a form of *flex cropping* where the farmer evaluated the risk of crop failure in any one year based on the soil moisture in the spring. If the

decision was to crop, we had continuous cropping. This revealed a limitation in our analytical approach. In fact, continuous cropping as simulated by EPIC was not flexible, rather it was fixed and continual for the 400 year simulation period.

EPIC was well suited to the simulation of the long-term impact on soil productivity and NPSP risk of various land uses. The long-term averages in biomass, crop yields (as indices of soil productivity), and the lateral and downward movement through the soil column of nitrates and phosphates (as indices of NPSP risk), generated by EPIC, can be used to infer the environmental impacts of GRIP and NISA induced land use changes. We also calculated estimates of the decrease in soil organic matter (%) over time as an index of soil physical quality and fertility (especially cation exchange capacity (CEC)) (data not reported).

The cumulative impact of NISA on the environment was calculated by adding the estimated rates of soil erosion associated with each of the above land uses weighted for the areal extent of these land uses before (1990) and after (1992) the program. Because some of these impacts may be negative while others may be positive, the overall impact may be negligible. The resulting indices were estimates of the environmental impacts in terms of average eroded soil thickness in that reporting area attributable to land use changes under NISA.

The Seventeen Reporting Areas

Seventeen reporting areas were selected as representative of the agricultural regions of Canada. Western Canadian provinces with the largest areas of agricultural soils encompassed most of these reporting areas (13 of 17). Ontario's agricultural region was represented using two broad soil development categories: the melanic brunisols in the east along the St. Lawrence valley, and the brunisols in the south-west. The Atlantic Provinces are dominated by two major soil development categories: the luvisols, predominate in New Brunswick, and the podzols, predominantly in Nova Scotia.

Reporting Area 1. Brown Chernozems (A1) in Alberta (AB)
Reporting Area 2. Dark Brown Chernozems (A2) in Alberta (AB)
Reporting Area 3. Black Chernozems (A3) in Alberta (AB)
Reporting Area 4. Solonetzic Soils (B1, B2, B3, B4) in Alberta (AB)
Reporting Area 5. Gray Luvisols (C2) in Alberta (AB)
Reporting Area 6. Gray Luvisols (C2) in the BC Peace River Region (BC)
Reporting Area 7. Brown Chernozems (A1) in Saskatchewan (SK)
Reporting Area 8. Dark Brown Chernozems (A2) in Saskatchewan (SK)
Reporting Area 9. Black Chernozems (A3) in Saskatchewan (SK)
Reporting Area 10. Gray Luvisols (C2) in Saskatchewan (SK)
Reporting Area 11. Black Chernozems (A3) in Manitoba (MN)
Reporting Area 12. Dark Gray Chernozems (A4) in Manitoba (MN)
Reporting Area 13. Gray Luvisols (C2) in Manitoba (MN)
Reporting Area 14. Gray Brown Luvisols (C1) in Ontario (ON)

Reporting Area 15. Brunisolic Soils (E1) in Ontario (ON)
Reporting Area 16. Gray Luvisols (C2) in the Atlantic Provinces (AP)
Reporting Area 17. Podzolic Soils (D2) in the Atlantic Provinces (AP)

Land Use Diversity Indices (LUDIs)

According to Merriam et al. (1993), in order to assess the degree to which the spatial configuration of the vegetation mosaic influences ecosystem processes, methods for quantifying the spatial character of the landscape are required. There are apparently two complementary ways to quantify the landscape mosaic: 1) measuring characteristics of the individual component patches, and 2) using indices that describe the relationships between the patches for the whole landscape. The spatial patterning of ecosystem types is a unique new phenomenon that arises at the landscape level (Klopateck et al. 1983). The problem, therefore, is to detect and quantify pattern in the spatial heterogeneity of landscapes (O'Niell et al. 1988).

Land use diversity indices (LUDI) were calculated using the survey data. LUDIs were an adaptation of the Shannon-Wiener Function (Krebs 1989). Strictly speaking, the Shannon-Wiener function should be used only on random samples drawn from large communities in which the total number of species is known. To obtain this information we used both Statistics Canada's Census of Agriculture data on a provincial basis, and the actual survey results on a reporting area basis. Changes in land use diversity were inferred if the provincially based LUDI changed dramatically from the 1986 to the 1991 census period. Changes in land use diversity also were inferred if the LUDI, based on reporting areas, changed from 1990 to 1992.

Land use diversity indices (LUDI) were calculated as follows:

$$LUDI = \Sigma\ p_i * \ln(p_i)$$

where **p** is the percentage of the reporting area or province occupied by crop species or land use *i*. On a provincial basis *i* included all various grains and oilseeds, whereas on a reporting area basis, grains and oilseeds were aggregated.

3.7 SYNTHESIS AND INTEGRATION OF FINDINGS

The environmental assessment framework adopted for this assessment included several lines of investigation. The use of descriptive, statistical and theoretical approaches was dictated by the availability of data to address the various environmental issues of concern. Not surprisingly then, the potential existed for inconsistencies in conclusions reached.

The various investigators associated with the study team convened amongst themselves and with Agriculture Canada representatives to discuss the strengths and weaknesses of the data

bases used to draw conclusions and the robustness of the conclusions. The participants concluded that where inconsistencies occurred, that the greatest degree of confidence would be associated with conclusions derived from the quantitative analysis of the survey data. The conclusions derived from the conceptual and theoretical description of NISA, and the opinions expressed in either the written submissions or the cross-Canada interviews were considered to warrant the least emphasis. Conclusions from the simulation studies using EPIC to evaluate soil erosion and non-point source pollution were deemed to lie somewhere in between. Hence, where inconsistencies or conflicts in conclusions arose, we relied upon the conclusions generated by the evidence derived from the farmer surveys.

3.8 MITIGATION MEASURES

Once the extent and significance of the environmental impacts of NISA in each soil zone and province were known, it was possible to begin to think about mitigation measures. Two principal types of measures were investigated, namely, measures involving modifications to NISA itself, and other types of measures not associated directly with the program, such as enhanced or expanded soil conservation or habitat protection programs.

The examination of program modifications included a special study of the feasibility and appropriateness of environmental compliance measures ("cross-compliance") such as those that have been implemented in the United States under the Food Security Act (FSA 1985) and the Food Agriculture Conservation and Trade Act (FACTA 1990). These include requirements that farmers implement approved soil conservation farm plans if they cultivate highly erodible lands, or risk loss of eligibility for program benefits under a broad range of farm programs. Prohibitions against draining wetlands ("swampbuster") and against bringing formerly uncultivated marginal lands into cultivation ("sodbuster") are other features of the US farm legislation that we wanted to assess from a Canadian perspective.

As explained in chapter one and in the Terms of Reference for this study (see Appendix I), the Federal-Provincial GRIP Agreement calls for the definition of the "circumstances and conditions under which insurance may be withheld, restricted or enhanced, for the purpose of protecting the environment". Similar requirements are included under the crop insurance and NISA agreements, consistent with Section 5(2)(a) of the Farm Income Protection Act. Consequently, a special effort was made to identify and assess what those "circumstances and conditions" might be, and to propose an approach to implementation that would be most likely to win support from both farmers and environmental interest groups.

4.0 THEORETICAL AND CONCEPTUAL ASSESSMENT

4.1 INTRODUCTION

Risk management strategies available to Canadian farmers include risk-reducing inputs, production diversification, holding reserves, gathering information, purchasing insurance and forward pricing contracts. The actual combination of risk management strategies selected by an individual depends upon a producer's attitude toward risk, the expected value of farm income and the probability distribution of incomes. Government programs can affect both the average level of income, the size and shape of the probability distribution of incomes or leave the set of events unchanged but alter the set of possible consequences. Government programs then have the potential to influence the risk management strategy followed by farmers. Prior to evaluating how NISA could affect a farmer's risk management strategy, this chapter will initially discuss the nature of approaches to risk management, and then specific risk management strategies and NISA.

4.2 RISK

Certainty is a circumstance where there is a one-to-one correspondence between an action and its consequences. In this situation, an individual making the decision knows both the nature of the event that will occur and how the event will affect the action selected. For example, a farmer purchasing a guaranteed investment certificate (GIC) which matures in one year, knows the accrued interest which will occur. The accrued interest is the event which occurs and the effect of the interest upon the decision maker is also known.

Uncertainty introduces the possibly of more than one consequence because many different events may arise between the time the decision is made and the consequences are felt. A deposit in a NISA account earns the Canadian treasury bill rate plus 3 percent interest. The treasury bill interest rate changes directly with events affecting the financial market. Canadian treasury bill rates are influenced by world interest rates, domestic monetary policy, international trade and exchange rates between the Canadian dollar and other currencies. Even with the 3 percent bonus added to the NISA interest rate, the accrued interest may not exceed that of a GIC. When a sum of money is deposited in a NISA account, the farmer does not know in advance what the accrued interest will be.

Investing some money within the farm has even greater uncertainty. For example, many possible events could occur between a decision to purchase stocker cattle and sell them as feeders at some point in time in the future. During this interval, live cattle prices could rise or fall, grazing capacity may be abundant or have to be supplemented because of drought, and animal mortality may increase with disease or predators. Hence, chances exist that either large gains or losses will occur.

Risk involves the chance of gain as well as loss. The gain or the loss affects the well-being of the decision maker. Robinson and Barry's (1987) definition of risk involves both

components, namely that the outcome of an action must have consequences for the decision maker, and that the decision maker's belief on how future events will unfold establishes the riskiness of the action prior to the decision.

Distinguishing between uncertainty inherent in some events and the riskiness of the consequence is an important distinction when evaluating risk management strategies. Some strategies change the possible set of events while others leave the events unchanged and alter the set of consequences. For example, self-protection through planting disease resistant seeds lowers the probability of rust reducing crop yields. Crop insurance, as a strategy, will not change the events reducing crop yield but will offset the consequences of lower yields. NISA is similar to crop insurance in that it does not change the possible events following certain actions, but it reduces the financial adversity stemming from the events.

4.2.1 Measuring Risk

Risk is subjective in terms of the decision maker's evaluation of future events and consequences. It follows then that risk depends upon the individual and the context within which the decision is made. Factors that cause the perception of risk to change include the expected value of the outcomes, dispersion of outcomes, the time interval between the action and consequence, personal circumstances of the decision maker and economic diversity of the organization making the decision.

Expected values are calculated by first weighing each consequence by its probability of occurrence. The expected value of an action is the sum of the product of each occurrence when multiplied by its corresponding probability. If every consequence (occurrence) is equally likely, their average and the expected value will be the same. This is the case for uniform and normal distributions of incomes shown in Figure 4.2.1. For both uniform and normal distributions, there is either an equal probability or an equal total weighted value of incomes above and below the expected value.

The long-term expected value of a farm's income after contributing matching deposits to a NISA account for a number of years will be higher than without participating. This assumes the matching government monies and accumulated interest exceed the returns from other investment opportunities. The distribution of income outcomes with a NISA account are not only likely to increase the expected value, but also shift the dispersion of outcomes.

This dispersion of outcomes has a bearing upon choices if the perceived riskiness of a particular choice depends upon the farmer's situation and concern with respect to a particular outcome. For example, if a farmer has minimal cash reserves or liquid assets to buffer an adverse event he/she may be reluctant to choose growing certain crops with higher expected income because of their susceptibility to an adverse event. For example, some pulse crops are perceived to be more susceptible to yield reducing pathogens than spring wheat. Therefore, the possibility of a total crop failure is present when lentils or peas are seeded while this is not the case with wheat.

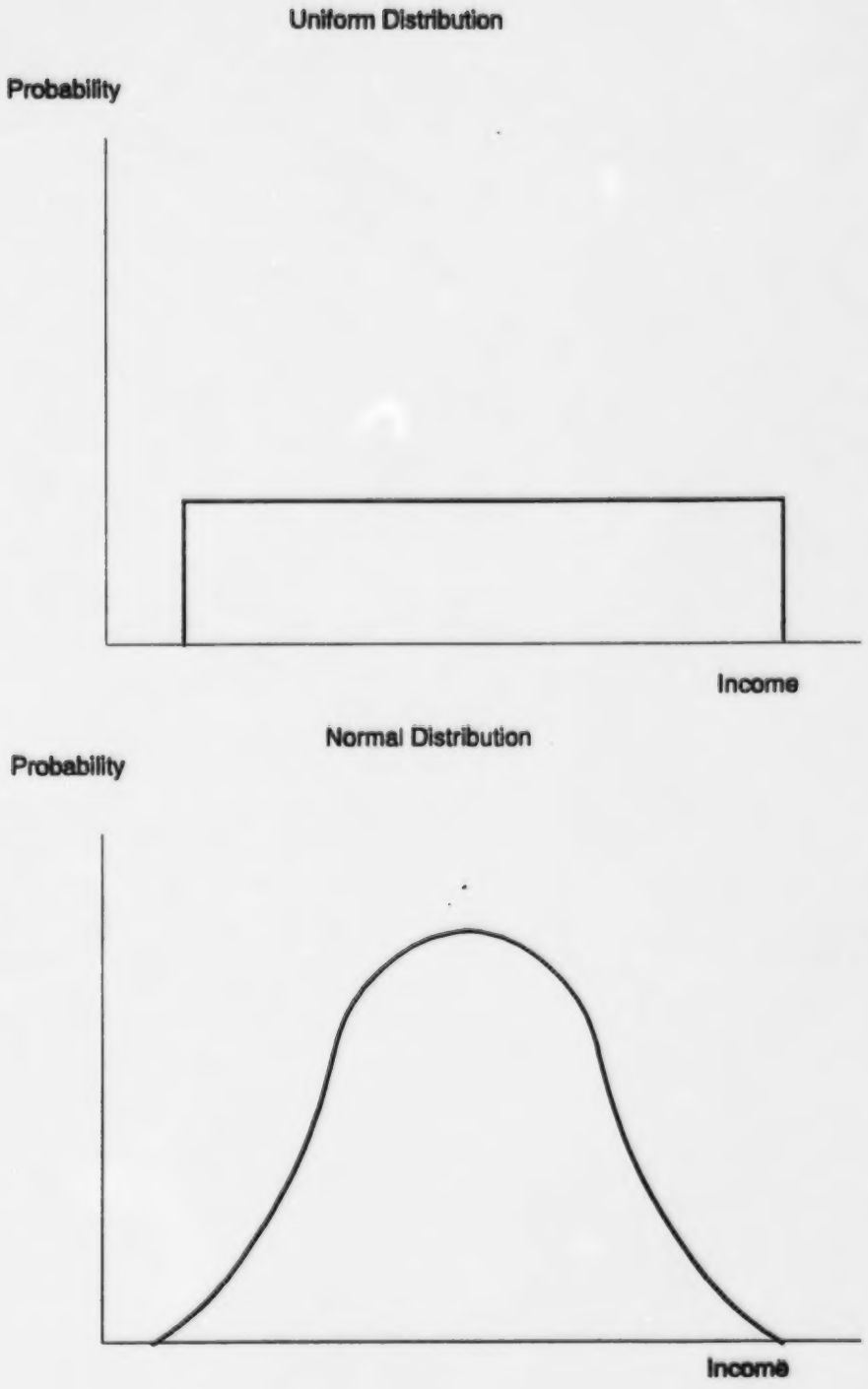

FIGURE 4.2.1 Uniform and Normal Distributions of Incomes

The notion that a set of events can be summarized by just the expected value is only true if the individual is risk neutral. Risk averters will sacrifice some amount of income to reduce the probability of low income consequences. This implies they will forgo some possible gains to reduce the probability of losses. Therefore, the dispersion of outcomes is important to risk averse individuals when planning their risk management strategies.

NISA is designed to influence the dispersion of year-to-year farm income. During years where the farm's gross margin exceeds the previous five-year average, the deposits to the NISA account will reduce a farm's cash flow but not its income. An individual's deposit during these higher income years is from after tax income and does not change the level of income expected nor the probability of occurring. On the other hand, when a farm's gross margin (net sales less eligible expenses) falls below the previous five-year average, the level of income changes as well as the probability of occurring because funds can be withdrawn from the government portion of the NISA account.

The distribution and shape of the income outcomes with and without a NISA account are shown in Figure 4.2.2. The "without" set of income outcomes represent the range of annual incomes a farmer perceives over a ten-year interval. The outcomes are assumed to be normally distributed about an expected value of $\overline{Y}$. By opening a NISA account, the individual becomes eligible to withdraw funds from the government portion of the account as well as their own account. The monies withdrawn that comprise the accumulated interest from the individual's fund plus the government contributions are used to augment the low income outcomes. Depending upon the amounts of government monies and accumulated interest in the NISA account, it may or may not be able to offset the total income lost in a year. In Figure 4.2.2, the amounts in the NISA account are assumed to be able to mitigate an income loss year and proportionally reduce the lower income effects. The net effect of NISA is to reduce the probability of a low income outcome, and by doing so raise the expected value from $\overline{Y}$ to $\overline{Y}^*$. The difference between the $\overline{Y}$ and $\overline{Y}^*$ is the average annual government contribution and accumulated interest.

Clearly, whether an individual is risk averse, risk preferring or risk neutral, a NISA account with matching government monies presents a preferred set of outcomes. If, and only if, the funds earmarked for a NISA account could return higher after tax incomes through other farm investments, will the expected value of future incomes be higher by declining the opportunity to deposit monies in a NISA account. When these opportunities are open to risk neutral or risk preferring farmers, they will be less willing to participate in NISA.

The perceived riskiness of an action will also vary according to the setting in which the decision is being made. For example, when reviewing the return of a particular crop from a specialized grain farm, it may be quite risky because of yield and price variability. When, however, evaluated in the context of a farm with a livestock enterprise, the crop could decrease the farm's overall risk. This would likely be the case with certain feed grains and forage crops. Therefore, the perceived distribution of income outcomes will vary from farm to farm because of the degree of specialization. As NISA contributions currently are linked

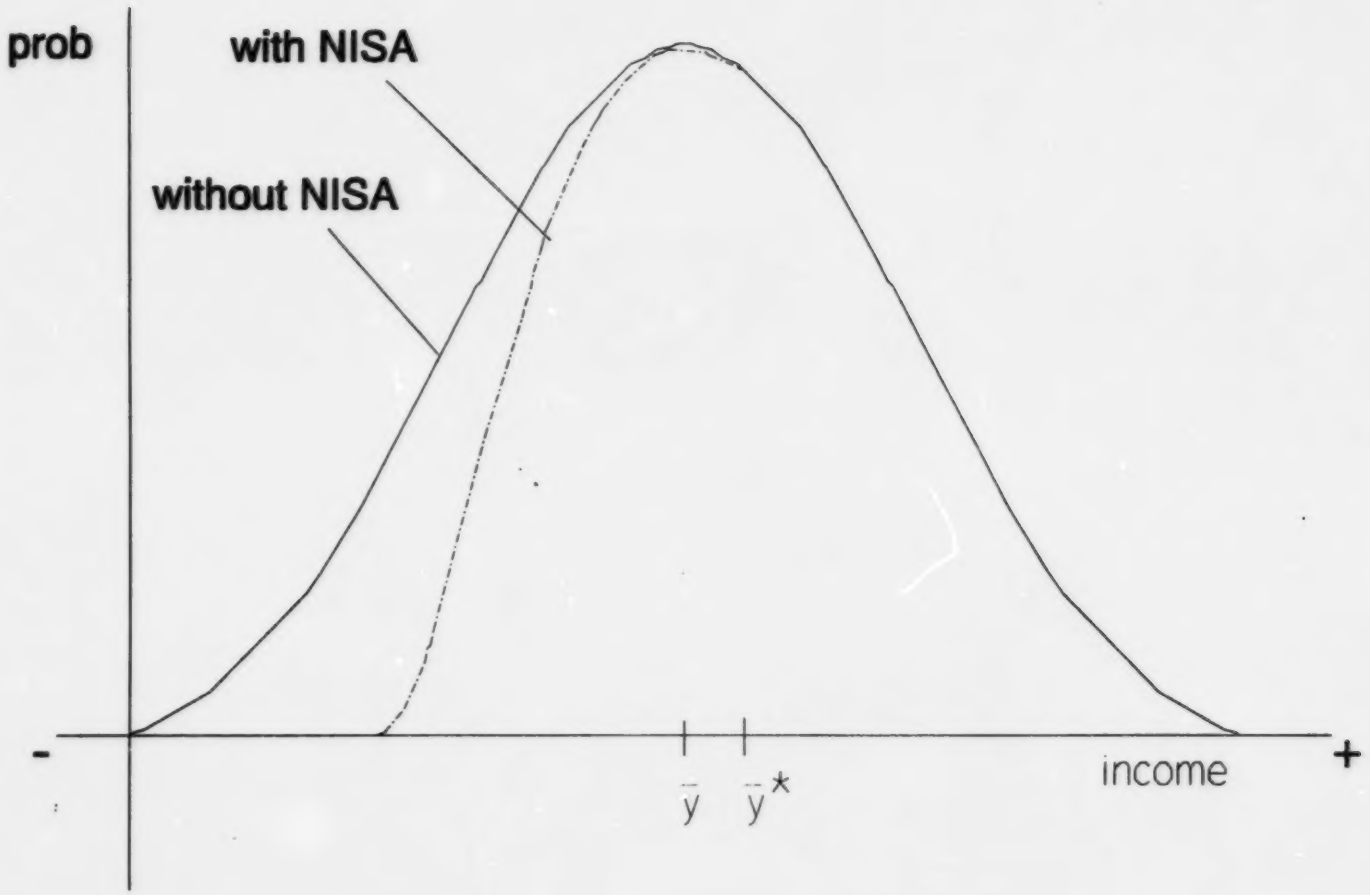

FIGURE 4.2.2 **Illustration of the probability distribution of income with & without NISA** where $\bar{y}^*$ & $\bar{y}$ represent expected income with & without NISA respectively

to just grains, oilseeds and edible horticultural crops, an account of this nature may not be viewed to a worthy stabilization consideration for a farm specializing in livestock.

4.3 APPROACH TO RISK MANAGEMENT

NISA is a risk management strategy that reduces the intertemporal variability of income. It belongs to a group of strategies called carrying reserves. These reserves can be feed, credit, and near cash assets, such as a NISA account. Feed reserves insulate ranchers from short-term fluctuations in the price of hay, feed grains or protein supplements. A line of credit or near cash assets are used to augment low income outcomes caused by unexpected expenses or a fall in receipts. Where the near cash assets merely involve liquidating after tax investments, this strategy does not increase the income earned during a year of adversity. Farm income remains the same but some assets are liquidated to meet ongoing financial obligations. If the near cash asset is a NISA account, the liquidation conditions represent a transfer of money from the government fund, and this is new income. Therefore, when the reserve is in the form of a NISA account, the farm income is higher in a year where the financial circumstances permit the farmer to withdraw funds from the account. Most reserve type operations merely transfer assets from one time period to another and have minimal influence upon the distribution or shape of the farm income. This form of self-insurance, does not normally come without a cost.

Many resources held in reserve do not earn a return and in some cases may diminish in value. For example, when hay is harvested it is counted as income for the year in question. By building up the stocks of hay, the farmer is transferring assets from one year to the next. If some of the hay inventory deteriorates, less is available in the following year. Only when the price of replacement hay increases above that of the previous year plus any perishability losses, does the hay reserve system increase farm income. Similarly, if accrued interest is claimed as taxable income during the year in which it occurs, a savings account does not augment income in years with lower farm income. To the extent that farmers have the option of reporting their income on a cash basis, there is the opportunity to shift some accrued income to the low income years. Therefore, holding reserves can, to a limited extent, shift some incomes from higher income years to lower income years. The net effect, because of cash accounting, is to decrease the dispersion of the probability distribution of net after tax farm income. Holding reserves, however, when income is measured and taxed on an accrual basis, will have minimal influence on the shape of the probability distribution of income outcomes. Only a NISA-type reserve which augments income can influence the shape and size of the distribution of outcomes.

4.3.1 Other Risk Management Strategies

Besides holding reserves, farmers can use risk reducing inputs, diversify their revenue sources, seek more information while developing and implementing their business plan, purchase insurance and forward contract some expenses or sales. Risk reducing inputs include seeds, pesticides, vaccinations and drugs. These are all forms of self-protection.

Whether the strategy is to seed rust resistant wheat varieties, apply fungicides, insecticides or herbicides or inoculate livestock, each involves an additional expense. Their effect upon the probability distribution of income should be to reduce the frequency of low income events. The effect upon expected income is dependent on the cost of each self-protection measure relative to the reduced incidence of low income outcomes. Unlike risk-reducing inputs whose effects are recorded field-by-field, or pen by pen, the effects of diversification are registered in terms of the combined enterprises on a farm.

4.3.1.1 Diversification

By engaging in multiple enterprises where the income of one enterprise is not correlated exactly with another, the dispersion for the probability of income outcomes is reduced. Enterprise diversification may reduce both the expected value and the maximum possible net farm income. Using more than one production practice, for example zero tillage and conventional tillage, or managing both livestock and cropping enterprises may involve giving up economies of scale. Higher costs and/or less production result in a lower net farm income. For a risk averse farmer, the amount of income sacrificed with diversified production may be less important than the reduced number of years with very low levels of income that may be present with specialization.

4.3.1.2 Information

Information used by farmers in developing a business plan is important in the formation of expectations about what may occur. The choice of production systems, marketing plans and risk management strategies are based upon some expectations of the future. Information on the expected delivery quotas and prices for crops marketed by the Canadian Wheat Board are signals to farmers in planning crop production. Demonstration trials and research findings on how to control problematic weed population represents information which may have a bearing upon a farmer's expectation. When information reduces the uncertainty surrounding some future events, farmers tend to revise their expectations and may select a different risk management strategy.

4.3.1.3 Insurance

All agricultural insurance policies affect the probability distribution of net farm income in a similar manner. An all risk crop insurance contract requires the farmer to pay a premium, which reduces the maximum income attainable, but in turn reduces the likelihood of low incomes. Premiums vary with the crop insured, the individual's historical record and the level of coverage, while indemnities depend upon the average yield a farmer attained for each specific crop in relationship to the coverage provided in the contract. For most years, all risk crop insurance is merely a cost that reduces a farmers income. However, whenever events such a drought, excess moisture, frost, pests and disease reduce yields below the coverage levels, indemnities raise farm incomes.

Figure 4.3.1 illustrates a probability distribution of income with and without all risk crop insurance. The level of income is lower for the crop insurance distribution of income whenever the premium reduces net income and no indemnities occur. However, given that indemnity payments exceed producer premiums (government contributions are included in the indemnity), the expected level of farm income with crop insurance ($\overline{Y}^*$) exceeds the level without insurance $\overline{Y}$. Therefore, for the farmer who believes the indemnity payments will exceed premiums paid over the planning period, crop insurance raises expected income and reduces the likelihood of incomes falling below some specified level.

4.3.1.4 Moral Hazard and Adverse Selection

One problem with crop insurance contracts is that it is difficult to adjust premiums to account for individual farmer's use of self-protection measures. This gives rise to moral hazard and adverse selection. Moral hazard arises because the insuring agent is uncertain about how a farmer will behave after signing the contract.

Recent literature in the area of agricultural insurance illustrates that the decision to purchase crop insurance is like the decision to purchase any other production input. Participation must result in a net increase in total utility (Nelson and Loehman 1987, Chambers 1989). Therefore, if the producer is risk neutral, he equates the expected marginal cost of insurance to the expected marginal revenue[1]. In other words, he is willing to pay a price for insurance up to the point where the expected indemnity is equal to the premium[2]. The expected indemnity of insurance, as it has been illustrated in the literature (Skees and Reed 1986, Nelson and Loehman 1987) is shown below:

$$EI = p \cdot \int_0^{y^l} (y^l - y) f(y/x) dy \qquad (1)$$

where: EI is the expected indemnity of insurance, p is the insurance indemnity price, f(y/x) is the probability density function of yield given a particular level of input use, and y^l is the guaranteed yield provided by crop insurance.

If the insurance corporation assumes optimal input use, x^* (i.e., that moral hazard is not a concern), then equation (1) represents the indemnity the corporation expects to pay on each acre insured for an average year and sets insurance premiums accordingly. However, in any given year when the farmers' decision to insure is made, conditions are seldom average.

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[1] Unless stated otherwise, we assume risk neutrality throughout the paper.

[2] Risk averse individuals discount the marginal cost of insurance and, as a result, are willing to pay more than the risk neutral individual for the same level of coverage (Nelson and Loehman, 1987).

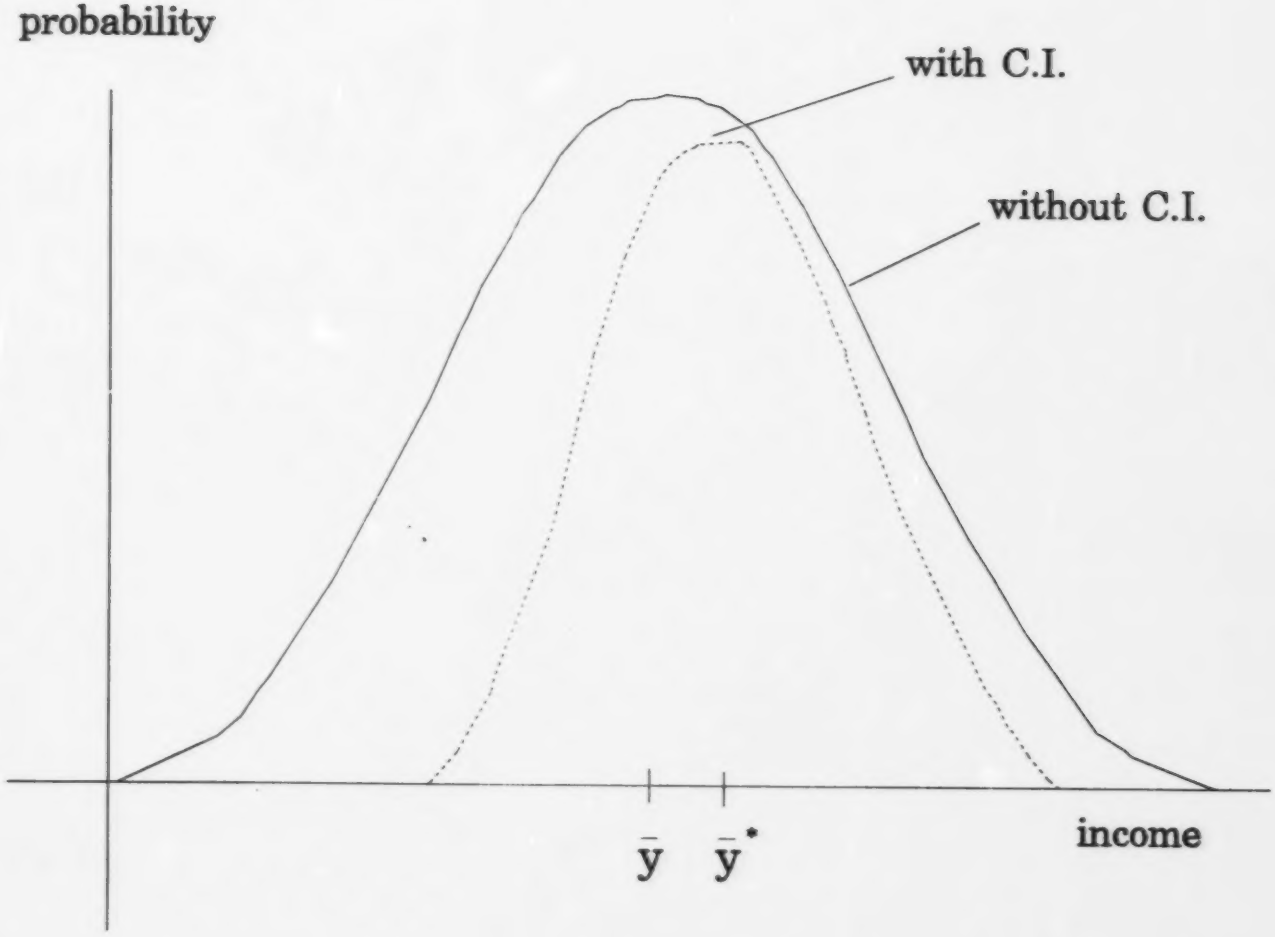

FIGURE 4.3.1 **Probability distribution of income with & without C.I.**
where $\bar{y}^*$ and $\bar{y}$ represent expected income with & without C.I. respectively

Therefore, the producers probability density function for crop yield is seldom the same as the probability density function (pdf) used by crop insurance corporation which is illustrated in equation (1). The remainder of this section discusses the many factors which may result in a producer's pdf being different from the corporation's and the implications this has for adverse selection and moral hazard with particular emphasis on the issue of selective participation.

Empirical research on crop production shows that one of the most important factors influencing crop yields is spring soil moisture at seeding time (Clark and Furtan 1984). Given this evidence, it seems reasonable that many producers use this additional piece of information to aid in their annual decision to purchase crop insurance. The addition of available spring soil moisture (w) influences the pdf presented in equation (1) and, thus, alters expected indemnities as illustrated in equation (2) below because $\delta E(y)/\delta w \geq 0$ for the vast majority of springs (i.e., flooding is very seldom a problem).

$$EI = p \cdot \int_0^{y^I} (y^I - y) f(y/x, w) dy \qquad (2)$$

Where (w) is the level of spring available soil moisture which positively affects expected yields, and all other variables are the same as they are defined in equation (1).

Given this information, consider a producer who, prior to planting, has the option of insuring all of his crop, part of his crop, or none of his crop. We first consider the case where all crops grown are insured or not insured. Based on equation (2) above, it is our contention that farmers are less likely to participate in crop insurance in those years when moisture levels are high since, as shown above, the expected indemnity from insurance decreases with higher levels of soil moisture at planting time. In contrast, if soil moisture levels are low at planting, expected indemnities are high and, for a given premium rate, participation is more likely. Interestingly though, when soil moisture levels are low, there is also an incentive to participate and practice moral hazard. We illustrate this incentive below.

In Figure 4.3.2, two expected revenue curves are represented, $E(y;x,w^H)$ and $E(y;x,w^L)$ where Y is yield, w is available soil moisture at seeding time, and x is a given input, such as fertilizer, where input price is assumed to be constant. The high (H) moisture yield revenue function is $E(y;x,w^H)$ while $E(y;x,w^L)$ is the low (L) moisture yield function. The cost of the input is given by P_x x, while the crop insurance guaranteed yield, which is based on a percentage of the expected yield given average moisture conditions, is given by y^I. Given a crop insurance price of P, which is equal to the expected market price, the income guarantee from a complete crop failure is $P.y^I$.

Suppose that prior to deciding on whether to take out crop insurance or not, the farmer expects a revenue of $E(y;x,w^H)$ because spring soil moisture is high. Given relative product input prices, the risk neutral farmer will opt to use x^* of the input to produce output y^*,

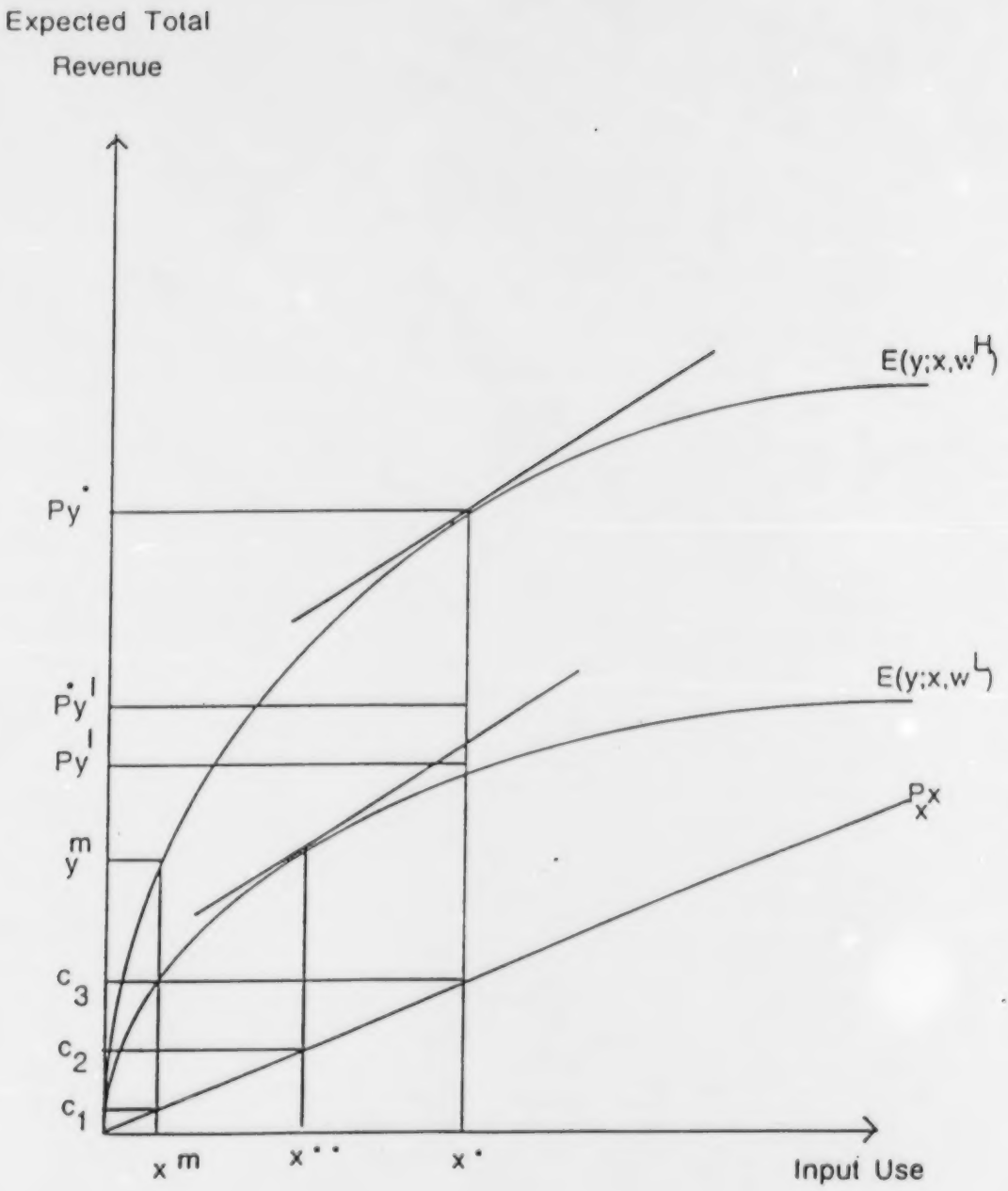

FIGURE 4.3.2 Moral Hazard, Spring Moisture and Commodity Prices

yielding a total revenue per acre of $P.y^*$. If he took out insurance and used x^* of the input, his actual yield would have to be below y^l to collect an indemnity from the insurance corporation. Given the high spring moisture conditions, if a minimum level of inputs, defined as x^m was used, he would have an expected loss of $(P.y^* - c_3) - (Py^l - c_1) > 0$. The minimum inputs are those which are needed to convince the crop insurance inspectors that some minimal level of farm practice has occurred. Therefore, when soil moisture conditions are high at seeding time, practising moral hazard has a significant short-term opportunity cost.

Suppose, in another year, moisture conditions are significantly lower at seeding time and as a result, the expected revenue function is $E(y;x,w^L)$. If the farmer decides not to insure, the optimum input use now is x^{**} (given the current price ratio). If the farmer insures but still uses x^{**} level of inputs, he/she earns $(Py^l - c_2)$ per acre because the crop insurance guaranteed revenue is greater than their expected revenue with optimal input use. The alternative is to practice moral hazard. By taking out insurance and practising moral hazard (i.e., using minimal level of inputs x^m), the farmer expects a net gain because $(P.y^l - c_1) - (Py^l - c_2) > 0$. The net gain from practising moral hazard in this case is $(C_2 - C_1)$ per acre. Therefore, when soil moisture levels are low, there is an identifiable incentive for farmers to practice moral hazard. This incentive exists whenever a participator perceives that the returns from operating optimally in the absence of insurance are less then the returns from operating at the minimal input level (x^m). In the case of risk-averse producers, this incentive is even greater because the moral hazard solution is a sure thing while operating at the optimal inputs in the absence of insurance is considerably more risky even if it may earn a slightly greater expected return than moral hazard.

Management ability also affects the expected value of insurance. As shown in equation (3) management (m) ability influences probability density function of yields in a manner analogous to spring available soil moisture.

$$EI = \int_0^{y^l} (P * y^l - P.y) f(y/x,w,m) dy \qquad (3)$$

Improved management ability has two hypothetical effects of the pdf of crop yields. The first is that better management will tend to increase expected yields while the second is that better management will tend to reduce the variability of yields. Both of these factors tend to lower the expected indemnity associated with participating in crop insurance as the corporation does not discriminate their contracts on the basis of management ability[3]. Therefore, it is reasonable that producers with higher level management will not participate

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[3] Over time, the corporation does adjust contracts for producers who have a "good" history with crop insurance by increasing their level of coverage and lowering their premium. However, it can take a number of years before adjustments occur as all producers in a given area on a given soil get identical contracts.

in the program continuously, as participation may only result in a net benefit in those years when soil moisture and expected yields are less than average.

4.4 RISK MANAGEMENT AND NISA

NISA falls within the risk management strategies that involve transferring assets from one time period into another. It reduces the year-to-year variability of income, not merely cash flow, because government funds augment the lower income years. The addition of government monies during low income years raises the overall average level of income a farmer can expect to earn over his/her lifetime.

The question of moral hazard in the context of NISA and reserve type risk management strategies has not been discussed in the literature. The question is: will the behaviour of a farmer with a NISA account deviate from the decisions followed when these financial reserves are unavailable? For example, will a farmer who has accumulated a sizeable balance in the NISA account be inclined to trigger a payment through cutting back on inputs or planting crops with greater revenue variability. Because of its intertemporal features, a current payment from NISA is likely to diminish the balance available when the farmer retires. Therefore, a decision to influence a payment today means giving up the same amount plus accrued interest upon retirement. Unlike insurance, where the costs of moral hazard are undefined higher premiums if the farmer wishes to renew the insurance, the cost of triggering a NISA payment today is less wealth in the future. Because the amount withdrawn today is unavailable in the future, it will be sufficient incentive for most individuals to not deliberately influence their gross margin which will result in a NISA payment.

One caveat to the condition that farmers will not be inclined to influence NISA payments occurs whenever the account balance reaches its ceiling. At this point, future wealth cannot be enhanced by leaving funds in the account. Access to these funds can only be realized when a farmer's gross margin falls below the previous five-year average, or when an individual's net income is less than $10,000. Monies are withdrawn first from the government fund in NISA. Under situations where the combined balances had accumulated to the upper limit, it is unlikely the government funds would be depleted by the withdrawal. Whereas the withdrawal is taxable, it provides the farmer access to government money with the option of making future contributions to NISA with matching amounts from the government. Unless the marginal tax rate on the funds withdrawn exceeds 50 percent, the individual will be financially better off to manoeuvre his/her gross margin so they are eligible for a payout. For example, assume a farmer has net sales of $100,000 per year and a combined NISA account balance of $150,000. Retirement is planned to occur in ten years. Triggering an eligible payment of $10,000 today with a 20 percent marginal tax rate leaves $8,000 for future NISA contributions. Over the next ten years, the farmer must only contribute $5,000 to the NISA account to replace the $10,000 withdrawn previously. Therefore, he/she has a net financial gain of $3,000.

Under what condition are farmers likely to reach the upper limit of their NISA account? With the ceiling set at one and one-half times the lesser of the average net sales in the most recent five year period or $375,000, the time required to reach the maximum depends upon the interest rate, deposits, and any funds withdrawn. Assuming maximum eligible deposits, no inflation, a real interest rate of 4 percent and no monies withdrawn, it will require 19 years before the ceiling is reached. Therefore, given the current NISA contributions of 2 percent of eligible net sales, this issue is not likely to arise for twenty years. This time frame also assumes no withdrawals. A condition of the NISA account is that when a farmer is eligible for a withdrawal, it must be taken if the account balance exceeds the average net sales of the previous five years. Under these conditions, the number of NISA account balances which reach the ceiling are likely to be a relatively small portion of all accounts. Therefore, the potential for the problem of producer engineered withdrawals is limited to unique circumstances and individuals.

Self-protection risk management strategies such as the usage of insecticides, fungicides, herbicides and seed varieties are unlikely to change in the context of holding cash reserves in a NISA account. Similarly, the incentives to choose specific crops produced within the set of those eligible for NISA will not change in the presence of funds held in a NISA account. Two risk management strategies, namely product diversification and crop insurance, may change for some farmers.

NISA contributions are limited to eligible sales of grains, oilseeds, most speciality crops and edible horticultural crops. NISA account reserves increase with deposits which are linked to sales or use of the aforementioned crops. On some farms, risk is also reduced through production diversification. NISA reserves can act as a substitute for diversification. When a NISA reserve reaches a level that the individual believes could buffer most low income events, participation in livestock production or off-farm employment will be viewed to be less critical. If these other non-cropping activities were pursued primarily for risk reduction, the farmer could specialize in crops, increase his/her income and have the security of the NISA reserve.

A NISA reserve may also be a preferable strategy to all risk crop insurance. Some farmers believe the premiums are too high in relationship to the coverage available. This occurs because their management ability reduces the probability of a claim below that determined by the crop insurance corporation. Rather than pay a crop insurance premium every year, it would be preferable for these farmers to draw from the NISA account when below average yields reduce their gross margin below the five-year average. Most crop insurance premiums exceed 2 percent of crop sales and the premiums saved could be in exchange for the NISA contribution. NISA represents another form of self-insurance. And when the self-insurance premiums are matched by government, the financial incentives to follow this risk management strategy increases.

The cost of self-insurance depends on the size of the loss. The cost, however, is independent of the probability of the loss. Consider the use of NISA as self-insurance. The cost of

completely insuring against a $5,000 loss requires the account to have $5,000 whether the probability of this occurring is low or high. When the $5,000 loss happens, the money is there to ameliorate the financial impact. Now consider self-insuring a $50,000 loss. This requires an accumulated balance of $50,000 in the NISA account. If a farmer decides to completely self-insure against a $50,000 loss, the amount available must be $50,000 whether the loss has a 5 percent or a 50 percent chance of occurring. Therefore, the cost of self-insurance is not being able to use these funds elsewhere in the business. By definition, the NISA balance is not available to be invested elsewhere in the farm. And as such, it represents a self-insurance fund where the only cost is a lessor amount available upon retirement.

NISA, as it is currently structured, is only a partial substitute for crop insurance. Only the amount accumulated in a NISA account is available for self-insurance. Losses in excess of the available funds remain at risk. Therefore, an on-going incentive to use crop insurance exists to protect against losses which exceed the monies set aside in a NISA account. If, however, a NISA account was permitted to have negative balance whenever the eligible withdrawals exceeded the funds available, it would represent a better self-insurance alternative.

A negative balance would allow the NISA account holder to offset extreme loss events. A negative balance need not imply the government is responsible for repaying the outstanding claim. Instead, before the individual could borrow against a NISA account, a lending institution would have to certify that the credit arrangements between the borrower (the farmer) and the lender were satisfactory. The lender could not turn to the government if the borrower failed to meet the financial obligation payments to retire the outstanding balance. The payments deducted would have to link to the annual deposit of 2 percent of the eligible net sales. Annual deposits from farmers and government would be used to retire the negative balance. Without this feature, NISA will only be viewed as self-insurance in the context of how effective the accumulated balance will be to ameliorate extreme losses.

NISA is a form of self-insurance similar to holding reserves of liquid assets or feed for livestock. In this context, NISA is not likely to be viewed by farmers as a replacement for self-protection risk management strategies that involve risk reducing inputs, preventive maintenance or spreading sales over different time periods. For some farmers, NISA will be a partial substitute for production diversification where the primary motive for diversification is risk reduction. In its present form, NISA has limited potential to substitute for all risk crop insurance or GRIP because the funds available cannot adequately offset extreme losses. In the case of other self-insurance schemes, such as inventory control, savings accounts and RRSP's, they are likely to show the greatest change in the presence of NISA. NISA will be preferred to these other options because the government contributions add to a farm's income as well as stabilizing cash flow and income. Most of the other strategies merely stabilize cash flow.

5.0 DESCRIPTIVE ASSESSMENT

5.1 INTRODUCTION

The descriptive assessment component of the analyses incorporated detailed summaries of written briefs submitted by interested individuals and organizations, summaries of information obtained through interviews of resource professionals in each province, and descriptive summaries of information gathered in the survey of program participants in each province (except Quebec). The intention of the descriptive analyses was to provide a clear picture of perceptions of farmers and others regarding possible linkages between NISA and the environment.

5.2 PRIMARY INFORMATION

5.2.1 Written Briefs

Twenty five written briefs were received from individuals and organizations from across Canada. A summary of the environmental issues included in the written briefs is provided in Figure 5.2.1. More detailed summaries of these briefs appear in Appendix IV.

5.2.2 Interviews With Resource Personnel

As was discussed in section 3.5, interviews were held with private and public agricultural and environmental resource personnel from across Canada. Only one of the individuals interviewed expressed any concerns about the environmental integrity of NISA. This individual concluded that NISA would be better for long-term agricultural/environmental stability if provisions were made in the contract to protect marginal lands and to include forages.

5.2.3 Mail Survey

As discussed in section 3.2, farmers from 2 distinct groups were sampled per soil zone: those enrolled in both GRIP and NISA programs ($n=450$ per soil zone) and those enrolled in NISA but not GRIP ($n=150$ per soil zone). Hence, 600 farmers were sampled per soil zone.

Response rates to the mail survey were good. The overall response rate for farmers receiving the GRIP/NISA questionnaire was 64%, ranging from a high of 74% in Ontario to a low of 58% in Saskatchewan (Table 5.2.3.1). The overall response rate for farmers receiving the NISA questionnaire was 61%, ranging from a high of 74% in Ontario to a low of 55% in British Columbia (Table 5.2.3.2).

Preliminary analyses revealed that the farmers enrolled in both programs were no more likely ($P > 0.05$) to be influenced by the NISA program than were farmers who were enrolled in the NISA program only. Therefore, both groups were pooled for subsequent

FIGURE 5.2.1

ENVIRONMENTAL ISSUES RELATED TO NISA BASED ON WRITTEN SUBMISSIONS

PAGE 1 OF 2

Organization/Individual	Largely No Effect	No Comment	Excludes Forages	Excludes Other Farm Products	Provides Econ. Stability to Promote Conservation
• Manitoba N.W. Soil Mgmt. Assoc.	√				
• Manitoba Farmer	√		√		
• Manitoba Organic Prod. Assoc.	√				
• Manitoba Instit. Agrologists		√			
• Ontario Corn Prod. Assoc.			√	√	
• Ontario Instit. Agrologists	√				
• Alberta Farmer	√				
• Alberta Farmer		√			
• Alberta Farmer		√			
• Sustain. Agric. Soc. Alta.		√			
• Alberta Conserv. Tillage Assoc.		√			
• Alberta Pool		√			
• Sask. Wheat Pool			√		√
• Sask. Organic Farmer		√			
• Sask. Wetland Conserv. Corp.		√			
• Back to Farm Res. Institute		√			
• Sask. Envir. Society		√			

FIGURE 5.2.1

PAGE 2 OF 2

Organization/Individual	Largely No Effect	No Comment	Excludes Forages	Excludes Other Farm Products	Provides Econ. Stability to Promote Conservation
• Sask. Soil Conserv. Society			√		
• Can. Fertil. Institute		√			
• Dryland Salinity Control Assoc.		√			
• West. Barley Growers Assoc.	√				
• Brewing & Malting Barley Res. Instit.	√				
• Ducks Unlimited Canada			√	√	
• Nature Conservancy Canada		√			

TABLE 5.2.3.1

MAIL SURVEY RESULTS FOR THE GRIP/NISA QUESTIONNAIRE

PROVINCE		TOTAL SAMPLED (n)	RESPONDENTS (n)	NON-RESPONDENTS (n)	REFUSALS (n)	UNDELIVERABLE (n)	DECEASED (n)	% RESPONSE[a]
British Columbia	(1)[b]	235	136	88	7	4	-	59%
Alberta	(5)	2250	1447	742	49	10	2	65%
Saskatchewan	(4)	1800	1048	668	78	4	2	58%
Manitoba	(3)	1316	879	407	27	2	1	67%
Ontario	(2)	900	661	219	17	3	-	74%
Atlantic Provinces	(1)	380	233	134	10	3	-	62%
TOTAL	(16)	6881	4404	2258	188	26	5	64%

[a] % Response = (Respondents) ÷ (Total Sampled - [Undeliverable + Deceased]) x 100
[b] Number of soil zones sampled within the province.

TABLE 5.2.3.2

MAIL SURVEY RESULTS FOR THE NISA QUESTIONNAIRE

PROVINCE		TOTAL SAMPLED (n)	RESPONDENTS (n)	NON-RESPONDENTS (n)	REFUSALS (n)	UNDELIVERABLE (n)	DECEASED (n)	% RESPONSE[a]
British Columbia	(1)[b]	365	197	142	18	5	3	55%
Alberta	(5)	750	430	277	27	12	4	59%
Saskatchewan	(4)	600	333	221	36	4	6	56%
Manitoba	(3)	484	304	158	17	3	2	63%
Ontario	(2)	300	215	72	5	4	4	74%
Atlantic Provinces	(1)	217	146	62	7	2	-	68%
TOTAL	(16)	2716	1625	932	110	30	19	61%

[a] % Response = (Respondents) ÷ (Total Sampled - [Undeliverable + Deceased]) x 100
[b] Number of soil zones sampled within the province.

analyses and the results reported herein were derived from all respondents to the mail survey.

5.2.3.1 Crop Mix

Crop selection may have changed once a farmer entered into a contractual agreement for one or all of the stabilization programs. Every year, cropping patterns change because of rotational considerations, weather and market events. However, the relative influence of a stabilization program was the focus of the questions completed by respondents. In each case, farmers were asked to concentrate their attention on the cropping changes they had identified as occurring between 1990 and 1992.

Overall, NISA influenced from 3% to 18% of the farmers in each province to change their crop mix from 1990 to 1992. A combined list of the percentage of farmers that were influenced by NISA is listed below by province: British Columbia (3%), Alberta (5%), Saskatchewan (4%), Manitoba (6%), Ontario (8%), Prince Edward Island (18%), Newfoundland (11%) and Nova Scotia (5%).

5.2.3.1.1 NISA and Risk Reduction

NISA generally was perceived by a majority of farmers as having not changed the risk of farming. Exceptions to the norm were the Atlantic Provinces where 65% of the Nova Scotia and Prince Edward Island farmers believed that risk was reduced. Conversely, 65% of the Newfoundland farmers assessed risk to be unchanged with NISA. Fifty-eight percent of the farmers in Manitoba and Alberta believed that risk was not affected by NISA while 62% in Ontario and British Columbia said that risk was the same as before opening a NISA account. Seventy percent of Saskatchewan farmers responded that risk of farming had not changed because of NISA.

A series of questions were asked to ascertain how farmers viewed the NISA account in their business plan. This was designed to reveal why the account was not considered by some as a self stabilizing force. Three investment alternatives were presented and farmers were asked to select their preferred strategy for income growth and stability. In all provinces except British Columbia, the preferred choice was expanding the amount of land and livestock before depositing money in an account for NISA or an RRSP. The land/livestock option was preferred only by 25% of British Columbian farmers. The majority of farmers that ranked land and livestock ahead of NISA or a RRSP ranged from 55% in Saskatchewan to 93% in Newfoundland. For the farmers whose first choice was land or livestock, they generally ranked a NISA contribution ahead of an RRSP contribution. In other words, if the funds were available after investing in land or livestock, approximately two of every three farms would prefer adding to their NISA account instead of their RRSP. Therefore on average, NISA was the second choice for about 45% of the farmers surveyed.

NISA ranked ahead of a livestock/land investment and an RRSP by 41% of the farmers in British Columbia and as low as 3% in New Brunswick. The list of provinces and the corresponding percentage of farmers that ranked NISA as their first choice is as follows: British Columbia - 41%, Alberta - 19%, Saskatchewan - 21%, Manitoba - 25%, Ontario 13%, Prince Edward Island - 15%, Nova Scotia - 16% and Newfoundland - 3%. When the investment rankings were cross tabulated with whether the perceived risk in farming changed since NISA, more farmers ranked NISA as a first or second choice if they believed risk had been reduced. The majority of farmers who happened to believe that risk had not changed since NISA ended up selecting the livestock/land option as their first or second choice. Therefore, before most farmers will be able to link NISA with self insurance and income stability, more information needs to be provided to account holders. Additionally, they probably must experience the opportunity to withdraw a sum of money which farmers view to be significant in offsetting an unexpected income shortfall.

Whether farmers viewed NISA to be risk reducing or a neutral factor in planning their farming operation could depend upon the amount of money they deposited in 1991. With exception of Prince Edward Island, at least two-thirds of the farmers responding to the survey questionnaire contributed less than $1000 to NISA. The corresponding percentage of farmers in each province that contributed less than $1000 to their NISA account was: British Columbia - 73%, Alberta - 69%, Saskatchewan - 77%, Manitoba - 68%, Ontario - 81%, Nova Scotia - 72%, Newfoundland - 70%, and Prince Edward Island - 57%. Over half of the respondents who deposited less than $1000 per year indicated their future contribution depended largely upon the funds they had available after meeting prior financial obligations. Between 8% and 13% of the farmers depositing less than a $1000 per year indicated they planned to cancel their NISA account in the next few years. Therefore, between 60% and 75% of the farmers depositing less than $1000 per year in their NISA account did not view this program as one that would stabilize their income in times of need. Self insurance requires that the financial reserve be of a sufficient size before farmers will rely upon it as a risk management strategy. At this early point in the history of NISA, sufficient funds have not been accumulated to represent a significant income buffer for most farms.

5.2.3.2 Herbicides

Weed control practices through application of herbicides were examined in the context of whether farmers changed this aspect of crop production because of NISA. The status quo was the overwhelming response on herbicide use in relation to the program. Depending upon the soil zone and province, NISA did not encourage changes in weed control for between 95% and 99% of the farmers. For the farmers who took NISA into consideration when implementing a new weed control plan, a larger number of farmers said they increased the amount of herbicides used, rather than decreasing it, in 11 of the 16 soil zones. A combined list of the percentage that increased or decreased herbicide usage in relation to NISA was: British Columbia (2% increased/<1% decreased), Alberta (2%/<1%),

Possible reasons for increasing herbicide use could have been because the mix of crops changed, an increased credit worthiness following NISA, or a desire to revise a crop's target yield. However, no rationale was sought in the questionnaire. Given the limited number of farmers that said they took NISA into consideration when using more herbicides, it is highly unlikely a consistent set of reasons could have been identified anyway.

5.2.3.3 Fertilizers

For the most part, the number of farmers claiming that NISA discouraged them to apply more fertilizer approximately equalled the number who expanded usage. The vast majority (at least 95% in any soil zone, except Newfoundland) stated that their fertility plans did not change in the presence of NISA. The provincial list showing the percentage of farmers increasing and decreasing fertilizer was as follows: British Columbia (<1% increased/1% decreased), Alberta (1%/1%), Saskatchewan (2%/1%), Manitoba (3%/<1%), Ontario (<1%/2%), Newfoundland (11%/0%), Nova Scotia (2%/<1%) and P.E.I. (5%/0%). Overall, more farms reduced the use of fertilizer than increased it in British Columbia and Ontario, while the converse was true in Saskatchewan, Manitoba and the Atlantic Provinces.

The responses, however, clearly indicate that most farmers did not interpret the terms of the NISA contract to mean they should decrease or increase the application of fertilizer. Further, the number that believed it was in their interest to reduce fertilizer use slightly exceeded the group who thought it was better to apply more. On the basis of the 1991 and 1992 experiences elicited from the survey, NISA did not appreciably change fertilizer use.

5.2.3.4 Tillage Practices

A series of questions in the survey asked producers what area of land they prepared for the 1990 and 1992 seasons using conventional, minimum, and zero-tillage methods. If their tillage methods changed between 1990 and 1992, the producers were asked to indicate whether NISA influenced their decision to change. Specifically, a question asked them to rate on a scale of 0 to 10 (10 being the sole influence), how much influence NISA had on their decision to change their tillage methods between 1990 and 1992 (see Appendix III). Inasmuch as we could not validate the accuracy of the reported scale scores (i.e., a farmer might have circled 3 when he should have circled 10), we collapsed these scales into 2 categories for our analyses: either the respondent was influenced by the program or they were not. Hence, our estimates of the percent changes in acreages due to NISA represent maximal values. For example, a farmer might only have been partially influenced by NISA to change his zero-tillage acreage from 100 acres in 1990 to 150 acres in 1992. However, for our analyses, because the farmer indicated that he was influenced by the program, we assumed that the net increase of 50 acres was 100% due to NISA, when in fact it was an undetermined value less than 50 acres.

Because some individuals, agencies, and organizations across Canada were interested in the influence of NISA on zero-tillage acreage, in this section we also assessed the corresponding changes in zero-tillage acreages due to the influence of NISA.

5.2.3.4.1 Alberta

Overall, not more than 1% of the producers in any given soil zone indicated that they were influenced to change their tillage practices by NISA (Appendix V: Table 1). In soil zone A1, NISA apparently had a slightly negative impact on tillage practices with more producers reducing their zero- and minimum-tillage acreages than did otherwise. Additionally, we estimated that there was up to a 0.2% decrease in the total acreage of zero-tillage as a result of NISA in soil zone A1.

Conversely, in soil zones A2, A3, and C2, NISA apparently had slightly positive impacts with more producers increasing their zero- and minimum-tillage acreages and reducing their conventional tillage acreages than did otherwise. Specifically, we estimated that there was up to a 0.4% increase in the total acreage of zero-tillage as a result of NISA in these respective soil zones.

5.2.3.4.2 Saskatchewan

Overall, not more than 1% of the producers in any given soil zone indicated that they were influenced to change their tillage practices by NISA (Appendix V: Table 2). Additionally, with the exception of soil zone A1, there was a net increase in the number of producers who increased their zero- and/or minimum-tillage acreages and reduced their conventional tillage acreage as a result of the program. In soil zone A1, there was up to a 0.1% decrease in the total acreage of zero-tillage as a result of NISA. In soil zones, A2 and A3, there were up to 0.2% and 0.1% increases in total acreages of zero-tillage, respectively, as a result of NISA. None of the producers in soil zone C2 indicated that NISA influenced them to change their zero-tillage acreages.

Therefore, based on the survey data, it appears that NISA had a slightly positive effect on tillage practices in all Saskatchewan soil zones except A1. In soil zone A1 it appeared that NISA had a slightly negative impact.

5.2.3.4.3 Manitoba

Overall, not more than 1% of the producers in any given soil zone indicated that they were influenced to change their tillage practices by NISA (Appendix V: Table 3). However, the influence of NISA on tillage practices varied among the three soil zones. In soil zones A3 and A4, NISA apparently had a slightly negative impact on tillage practices with more producers increasing their conventional tillage acreages and reducing their zero- and/or minimum-tillage acreages than did otherwise.

In soil zone C2, NISA apparently had a positive impact on tillage practices, with producers reducing their conventional tillage acreages and increasing their zero- and minimum-tillage acreages.

5.2.3.4.4 Ontario

Less than 5% of the producers in either soil zone indicated that they were influenced to change their tillage practices by NISA (Appendix V: Table 4). Additionally, more producers indicated that they increased their zero- and minimum-tillage acreages (both soil zones) and reduced their conventional tillage acreage (E1) as a result of NISA than did otherwise. Furthermore, it appeared that NISA actually was responsible for increases in zero-tillage acreages of up to 0.1% in soil zone C1 and 0.3% in soil zone E1.

5.2.3.4.5 British Columbia

Overall, less than 2% of the producers indicated that they were influenced to change their tillage practices by NISA (Appendix V: Table 5). Moreover, it appears that the impact of NISA was slightly positive because more producers increased their acreages of zero-tillage (increase of up to 0.4%) and reduced their acreages of conventional tillage than did otherwise.

5.2.3.4.6 Atlantic Provinces

Apparently, NISA influenced less than 3% of the producers in the Atlantic Provinces to change their tillage practices (Appendix V: Table 5). However, the impacts appeared to be neutral in Newfoundland and slightly negative in Nova Scotia and PEI.

5.2.3.5 Summerfallow Acreage

A series of questions in the survey asked producers what area of land they had in summerfallow during the 1990 and 1992 seasons. If their summerfallow acreages changed between 1990 and 1992, the producers were asked to indicate whether NISA influenced their decision to change. Specifically, a question asked them to rate on a scale of 0 to 10 (10 being the sole influence), how much influence NISA had on their decision to change their summerfallow acreage between 1990 and 1992 (see Appendix III). Inasmuch as we could not validate the accuracy of the reported scale scores (i.e., a farmer might have circled 3 when he should have circled 10), we collapsed these scales into 2 categories for our analyses: either the respondent was influenced by the program or they were not. Hence, as discussed in section 5.2.3.4, our estimates of the percent changes in acreages due to NISA represent maximal values.

5.2.3.5.1 Alberta

Not more than 3% of the producers in any given soil zone indicated that they were influenced by NISA to change the proportion of their summerfallow acreage between 1990 and 1992 (Appendix V: Table 6). Additionally, there were more producers in each soil zone who indicated that they were influenced to reduce their proportion of summerfallow than were influenced to increase it. These numbers corresponded with 0.1% - 0.7% decreases in the total acreages of summerfallow in the respective soil zones. Therefore, with respect to summerfallow acreage, it appears that the impacts of NISA were positive in Alberta.

5.2.3.5.2 Saskatchewan

Not more than 3% of the producers in any given soil zone indicated that they were influenced by NISA to change the proportion of their summerfallow acreage between 1990 and 1992 (Appendix V: Table 7). Furthermore, with the exception of soil zone A1, more producers indicated that they were influenced to reduce their proportion of summerfallow than were influenced to increase it. These numbers corresponded with 0.2% - 1.0% decreases in the total acreages of summerfallow in the respective soil zones. In soil zone A1, NISA apparently had a slight negative impact with more producers being influenced to increase their proportion of summerfallow than were influenced to increase it. In soil zone A1, this corresponded to a slight (<0.1%) increase in summerfallow acreage.

5.2.3.5.3 Manitoba

Not more than 4% of the producers in any given soil zone indicated that they were influenced by NISA to change the proportion of their summerfallow acreage between 1990 and 1992 (Appendix V: Table 8). Additionally, in soil zones A4 and C2, more producers indicated that they were influenced to reduce their proportion of summerfallow than were influenced to increase it. These numbers corresponded with up to 0.2% decreases in the total acreages of summerfallow in the respective soil zones. In soil zone A3, as many people increased their summerfallow acreages as a result of NISA as reduced them. However, our estimates revealed there was a slight increase (0.1%) in summerfallow acreage in soil zone A3.

Therefore, with respect to summerfallow acreage, it appears that the impacts of NISA were positive in soil zones A4 and C2 and slightly negative in soil zone A3.

5.2.3.5.4 British Columbia

In British Columbia, 2% of the producers indicated that they were influenced by NISA to change their proportions of summerfallow acreage (Appendix V: Table 9). Furthermore, there were twice as many producers who indicated that they were influenced to reduce their proportion of summerfallow than were influenced to increase it. This corresponded with up to a 0.8% decrease in total summerfallow acreage as a result of NISA.

5.2.3.6 Summerfallow Cultivation Practices

A series of questions in the survey asked producers how many times they cultivated their summerfallow acreages during the 1990 and 1992 seasons. If the number of cultivations changed between 1990 and 1992, the producers were asked to indicate what influenced their decision to change. However, unlike the other series of survey questions in this section (5.2.3), specific questions about the influence of NISA were not provided. Rather, a single open-ended question asked the producers why they changed the number of cultivations.

5.2.3.6.1 Alberta

Only one producer in Alberta (0.7%, 0.7 [SE]) indicated an influence by NISA to change the number of summerfallow cultivations between 1990 and 1992 (Appendix V: Table 10). This individual indicated that he was influenced to decrease the number of cultivations. Therefore, it appears that NISA had virtually no effect on the number of times producers cultivated their summerfallow.

5.2.3.6.2 Saskatchewan

None of the Saskatchewan producers indicated that they were influenced by NISA to change the number of times they cultivated their summerfallow between 1990 and 1992 (Appendix V: Table 11). Therefore, it appears that NISA had no effect on the number of times producers cultivated their summerfallow in Saskatchewan.

5.2.3.6.3 Manitoba

None of the Manitoba producers indicated that they were influenced by NISA to change the number of times they cultivated their summerfallow between 1990 and 1992 (Appendix V: Table 12). Therefore, it appears that NISA had no effect on the number of times producers cultivated their summerfallow in Manitoba.

5.2.3.6.4 British Columbia

None of the British Columbia producers indicated that they were influenced by NISA to change the number of times they cultivated their summerfallow between 1990 and 1992 (Appendix V: Table 13). Therefore, it appears that NISA had no effect on the number of times producers cultivated their summerfallow in Manitoba.

5.2.3.7 Riparian Zones

A series of questions in the survey asked producers if they had any lakes, rivers or streams on or bordering their farmlands; and if so, what the average distance was from the edge of their croplands to the water's edge in 1990 and 1992. If this distance changed, the producers

were asked to indicate whether NISA influenced their decision to change the riparian zone width.

5.2.3.7.1 Alberta

Overall, none of the producers in soil zones A1 and A2 indicated that they were influenced by NISA to change the width of their riparian zones (Appendix V: Table 14). However, 1.1% (1.1) and 1.0% (1.0) of the producers that had riparian zones in soil zones A3 and B, respectively, indicated that they were influenced by NISA to decrease the widths of their riparian zones. Conversely, 1.4% (1.0) of the producers in soil zone C2 indicated that they were influenced by NISA to increase the widths of their riparian zones.

5.2.3.7.2 Saskatchewan

With the exception of soil zone A2, Saskatchewan producers were not influenced by NISA to change the widths of their riparian zones (Appendix V: Table 15). In soil zone A2, 6.1% (2.4) of the producers that had riparian zones indicated that NISA influenced them to decrease the widths of their riparian zones.

5.2.3.7.3 Manitoba

Apparently, none of the producers in soil zone C2 were influenced by NISA to change the widths of their riparian zones (Appendix V: Table 16). However, 0.7% (0.7) of the producers in soil zone A4 claimed that they were influenced by NISA to decrease the widths of their riparian zones and 0.9% (0.9) of the producers in soil zone A3 claimed that they were influenced to actually increase the widths of their riparian zones.

5.2.3.7.4 Ontario

NISA appeared to have a positive influence on riparian areas on Ontario farmlands. Between 3.0% (1.2) and 3.5% (1.3) of the producers with riparian areas on their lands indicated that they actually increased the widths of these areas due to the NISA program (Appendix V: Table 17).

5.2.3.7.5 British Columbia

None of the producers in British Columbia indicated that they were influenced by NISA to change the width of their riparian areas (Appendix V: Table 18).

5.2.3.7.6 Atlantic Provinces

Overall, NISA appeared to have a slight positive influence on riparian areas in the Atlantic Provinces. In PEI, 2.0% (1.4) of the producers with riparian areas indicated that they were influenced by NISA to increase the width of their riparian zones (Appendix V: Table 18).

Apparently, producers in Newfoundland and Nova Scotia were not influenced by NISA to change the width of their riparian areas.

5.2.3.8 Field Margins

A series of questions in the survey asked producers to disclose the average width of their field margins (e.g., fence rows, fence lines, field borders around crops, etc.) for the 1990 and 1992 field seasons. If this distance changed between time periods, the producers were asked to indicate whether NISA influenced their decision to change the width of their field margins.

5.2.3.8.1 Alberta

None of the Alberta producers indicated that they were influenced by NISA to change the width of their field margins (Appendix V: Table 19). Therefore, it appears that NISA had no effect on the width of field margins.

5.2.3.8.2 Saskatchewan

Overall, less than 1% of the producers in each soil zone indicated that they were influenced by NISA to change the widths of their field margins (Appendix V: Table 20). In soil zones A1 and A2, as many producers were influenced to increase as were influenced to decrease the widths of their field margins. In soil zones A3 and C2, 0.4% (0.4) of the producers claimed that NISA influenced them to decrease the widths of their field margins.

5.2.3.8.3 Manitoba

Less than 2% of the producers from any soil zone indicated that they were influenced by NISA to change the widths of their field margins (Appendix V: Table 21). In soil zone A3, as many producers were influenced to increase as were influenced to decrease the widths of their field margins. In soil zone A4, 0.3% (0.3) of the producers claimed that NISA influenced them to increase the widths of their field margins. Conversely, in soil zone C2, more producers were influenced to decrease the widths of their field margins than were influenced to increase them.

5.2.3.8.4 Ontario

Less than 1% of the producers from either soil zone indicated that they were influenced by NISA to change the widths of their field margins (Appendix V: Table 22). In soil zones C1 and E1, 0.3% (0.3) and 0.8% (0.4) of the producers, respectively, claimed that NISA influenced them to decrease the widths of their field margins.

5.2.3.8.5 British Columbia

None of the British Columbia producers indicated that they were influenced by NISA to change the width of their field margins (Appendix V: Table 23). Therefore, it appears that NISA had no effect on the width of field margins.

5.2.3.8.6 Atlantic Provinces

Apparently, NISA did not influence farmers in Nova Scotia to change the widths of their field margins (Appendix V: Table 23). However, 4.5% (4.4) of the producers in Newfoundland, who provided information on the widths of their field margins, indicated that NISA influenced them to increase the widths of their field margins. Conversely, in PEI, more producers were influenced to decrease the widths of their field margins than were influenced to increase them.

5.2.3.9 Wetland Margin Degradation

A series of questions in the survey asked producers if they had any wetlands on their farmlands; and if so, if they cultivated any closer to these wetlands in 1992 than they did in 1990. If they indicated that they did cultivate closer in 1992, the producers were asked to indicate whether NISA influenced their decision to do so.

5.2.3.9.1 Alberta

Apparently, none of the producers in soil zones A1, A3, and C2 were influenced by NISA to change their wetland margins (Appendix V: Table 24). Moreover, 1.2% (0.8) and 0.4% (0.4) of the producers in soil zones A2 and B, respectively, indicated that they were influenced by NISA to increase their wetland margins. Therefore, it appears that NISA had a slightly positive impact on wetland margins in Alberta.

5.2.3.9.2 Saskatchewan

Apparently, none of the producers in soil zones A1, A2, and A3 were influenced by NISA to change their wetland margins (Appendix V: Table 25). However, 1.0% (0.7) of the producers in soil zone C2 indicated that they were influenced by NISA to decrease their wetland margins. Therefore, it appears that NISA had a slightly negative impact on wetland margins in Saskatchewan.

5.2.3.9.3 Manitoba

None of the producers in soil zone A4 indicated that they were influenced by NISA to change their wetland margins (Appendix V: Table 26). However, 0.6% (0.6) and 0.8% (0.5) of the producers in soil zones A3 and C2, respectively, indicated that they were influenced

by NISA to increase their wetland margins. Therefore, it appears that NISA had a slightly positive impact on wetland margins in Manitoba.

5.2.3.9.4 Ontario

None of the producers in soil zone E1 indicated that they were influenced by NISA to change their wetland margins (Appendix V: Table 27). However, 0.7% (0.7) of the producers in soil zone C1 indicated that they were influenced by NISA to increase their wetland margins. Therefore, it appears that NISA had a slightly positive impact on wetland margins in Ontario.

5.2.3.9.5 British Columbia

None of the producers in British Columbia indicated that they were influenced by NISA to change their wetland margins (Appendix V: Table 28). Therefore, it appears that NISA had no effect on the width of wetland margins.

5.2.3.9.6 Atlantic Provinces

None of the producers in Nova Scotia or Newfoundland indicated that they were influenced by NISA to change the widths of their wetland margins (Appendix V: Table 28). However, 2.7% (1.9) of the producers in PEI indicated that they were influenced by NISA to increase their wetland margins. Therefore, it appears that NISA had a slightly positive impact on wetland margins in the Atlantic Provinces.

5.2.3.10 Wetland Drainage

A series of questions in the survey asked producers if they had any wetlands on their farmlands; and if so, if they drained any of their wetlands in 1991 or 1992. If they indicated that they did drain $\geq$1 of their wetlands, the producers were asked to indicate whether NISA influenced their decision to drain.

5.2.3.10.1 Alberta

None of the producers in soil zones A1 and A2 indicated that NISA influenced them to drain wetlands (Appendix V: Table 29). However, 0.9% (0.6) of the producers in soil zone A3, 1.7% (0.8) in soil zone B, and 1.1% (0.8) in soil zone C2 indicated that NISA influenced them to drain $\geq$1 of their wetlands in 1991 or 1992. Therefore, it appears that NISA had a negative impact on wetlands in Alberta.

5.2.3.10.2 Saskatchewan

None of the producers in soil zone A3 indicated that NISA influenced them to drain wetlands (Appendix V: Table 30). However, 1.0% (1.0) of the producers in soil zone A1

and 0.5% (0.5) in soil zones A2 and C2 indicated that NISA influenced them to drain $\geq$1 of their wetlands in 1991 or 1992. Therefore, it appears that NISA had a negative impact on wetlands in Saskatchewan.

5.2.3.10.3 Manitoba

None of the producers in soil zone A4 indicated that NISA influenced them to drain wetlands (Appendix V: Table 31). However, 0.6% (0.6) of the producers in soil zone A3 and 0.8% (0.5) in soil zone C2 indicated that NISA influenced them to drain $\geq$1 of their wetlands in 1991 or 1992. Therefore, it appears that NISA had a negative impact on wetlands in Manitoba.

5.2.3.10.4 Ontario

In Ontario, producers in both soil zones indicated that NISA influenced them to drain wetlands (Appendix V: Table 32). In soil zone C1, 1.5% (1.0) of the producers indicated that NISA influenced them to drain $\geq$1 of their wetlands in 1991 or 1992. In soil zone E1, 0.5% (0.5) indicated that NISA influenced them to drain $\geq$1 of their wetlands in 1991 or 1992. Therefore, it appears that NISA had a negative impact on wetlands in Ontario.

5.2.3.10.5 British Columbia

In British Columbia, 1.3% (0.9) of the producers indicated that NISA influenced them to drain wetlands (Appendix V: Table 33). Therefore, it appears that NISA had a negative impact on wetlands in British Columbia.

5.2.3.10.6 Atlantic Provinces

None of the Newfoundland producers indicated that NISA influenced them to drain their wetlands (Appendix V: Table 33). However, 5.5% (2.7) of the producers in PEI and 1.9% (1.8) of the producers in Nova Scotia indicated that NISA influenced them to drain $\geq$1 of their wetlands. Therefore, it appears that NISA had a negative impact on wetlands in the Atlantic Provinces.

5.2.3.11 Perennial Forages

From province to province, and soil zone to soil zone, the survey results consistently indicated that over 92% of the farmers did not change the area in forages because of NISA. Most of the remaining group claiming to be influenced by NISA said their areas in perennial forages actually increased. In fact, in no soil zone did the number of farmers decreasing their acreages of perennial forages due to NISA exceed the number increasing them. These survey results contradict economic logic. A farmer can not contribute to his or her NISA account because of forage sales. Nonetheless, 1-8% or the respondents claimed that their forages increased because of NISA. No rationale can be offered for their judgement.

Most farmers surveyed did not change the relative area they seeded to forages and only a few decreased the area between 1990 and 1992. The net change in the surveyed area devoted to perennial forages grew in all provinces except Prince Edward Island. A provincial listing of the change in forage area follows: British Columbia (17%), Alberta (10%), Saskatchewan (9%), Manitoba (4%), Ontario (2%), Newfoundland (3%), Prince Edward Island (7%) and Nova Scotia (2%). Secondary data published by Statistics Canada showed that all hayland increased throughout Western Canada and decreased in each of the eastern provinces. With the exception of the sample sizes in the Atlantic Provinces, the remaining sample sizes should reflect the farming population if the distribution of the respondents was regionally and structurally representative. Without these assurances, the capability of accurately projecting how much total area seeded to hay had changed at the provincial level was speculative. Given the tendency of Statistics Canada to consistently revise between census estimations of hayland, one must be very cautious in projecting what the changes are to provincial cropland. Not withstanding these concerns, the survey results suggested that perennial forages increased and more respondents believed NISA contributed to the increase than those who purported that it caused a reduction in perennial forages.

5.2.3.12 Summary

Table 5.2.3.12.1 summarizes the impacts of NISA on land use and input decisions of farmers in the 16 study areas across Canada. Impacts are summarized as positive (+), negative (-) and neutral (0). The magnitude of these impacts was discussed in the previous sections and an overall impact assessment is provided in Chapter 7.

Crop Selection

Crop selection toward more of a monoculture setting was considered to have a negative environmental effect based on reduced diversity.

From 3% to 18% of the farmers in the respective provinces indicated that they were influenced by NISA to decrease the diversity of their crops. However, the majority (94%) of Canadian farmers were not influenced by NISA to change their crop selection. Overall, NISA was considered to have a negative environmental impact based on reduced crop diversity.

Fertilizer Use

An increase in fertilizer use was considered to be a potentially negative impact from the perspective of potential increases in non-point source pollution.

Overall, NISA influenced more farmers to increase their fertilizer inputs than to decrease them (8 of 16 study areas). In 7 study areas, the reverse occurred, with more farmers being influenced to decrease their fertilizer inputs than doing otherwise. In Alberta soil zone A2, equal numbers were influenced in each direction. However, less than 6% of the producers

TABLE 5.2.3.12.1

SUMMARY OF THE ESTIMATED[1] IMPACTS OF NISA ON FARMING PRACTICES AND LAND USE DECISIONS IN 1992

	B.C.	Alberta					Saskatchewan				Manitoba			Ontario		PEI	NS	NF
	C2	A1	A2	A3	B's	C2	A1	A2	A3	C2	A3	A4	C2	C1	E1			
Crop Selection	-[2]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fertilizers	+	+	o	+	-	-	-	+	+	-	-	-	-	+	+	-	-	-
Herbicides	-	-	-	-	-	-	-	+	+	-	-	-	-	+	+	+	+	o
Perennial Forages	+	+	+	+	+	+	o	o	+	+	+	+	+	o	+	+	+	o
Tillage Practices	+	-	+	+	o	+	-	+	+	+	-	-	+	+	+	-	-	o
Summerfallow Acreage	+	+	+	+	+	+	-	+	+	+	-	+	+					
Summerfallow Cultivation	o	o	o	+	o	o	o	o	o	o	o	o	o					
Riparian Zones	o	o	o	-	-	+	o	-	o	o	+	-	o	+	+	+	o	o
Field Margins	o	o	o	o	o	o	o	o	-	-	o	+	-	-	-	-	o	+
Wetland Margins	o	o	+	o	+	o	o	o	o	-	+	o	+	+	o	+	o	o
Wetland Drainage	-	o	o	-	-	-	-	-	o	-	-	o	-	-	-	-	-	o

1 Estimates derived from mail survey.

2 o = program was neutral; (-) = program had a negative influence; (+) = program had a positive influence

in any given soil zone, except Newfoundland, indicated that NISA influenced them to change their fertilizer inputs in 1992 from that which occurred in 1990. Therefore, based on volumes alone, NISA could have had a slightly negative impact on water quality as evinced by a net increase in fertilizer use in half of the study areas.

Herbicides

Like fertilizer utilization, increases in herbicide use were considered to have potentially negative impacts based upon contributions to non-point source pollution.

Overall, NISA influenced more farms to increase their herbicide inputs than to decrease them (11 of 16 study areas). However, in any given soil zone or province, at least 95% of the farmers indicated that NISA did not influence them to alter their herbicide application use relative to pre-NISA conditions. Therefore, based on volumes alone, NISA could have had a slightly negative impact on water quality as evinced by a net increase in herbicide use and application rates in over half of the study areas.

Perennial Forages

An increase in perennial forage acreage is considered to be a positive impact from soil erosion prevention and wildlife habitat perspectives.

Contrary to economic logic, despite no coverage under NISA for forage crops, NISA influenced farmers in 13 of 16 study areas to increase perennial crop acreage. However, it should be recognized that the majority of producers (97%) indicated that NISA did not influence them one way or the other. Hence, the positive impacts of forage acreage increase can be considered to be positive but relatively minor in nature.

Tillage Practices

An increase in zero-tillage use was deemed to be a positive impact because of soil erosion prevention and wildlife habitat improvement reasons.

Overall, in 10 of the 16 study areas, more farmers were influenced by NISA to increase their acreages under minimum - and zero-tillage systems. However, as less than 5% of the farmers in any given soil zone indicated that they were influenced by NISA one way or the other, the impact of NISA on conservation tillage practices could be considered positive yet relatively minor.

Summerfallow Acreage

A reduction in the amount of summerfallow acreage was deemed to be a positive impact in terms of the potential reduction in soil erosion, improved water quality and the provision of more wildlife habitat.

In 11 of the 13 study areas where summerfallowing was practised, more farmers decreased the amount of land in summerfallow as a result of NISA. In two of the soil zones, the opposite was the case. Proportions of farmers influenced to change their summerfallow acreages in response to NISA ranged from 3% to 7% for the affected soil zones. Furthermore, the actual decrease in summerfallow acreage amounted to less than 1% of the total summerfallow acreage in Western Canada. Thus, overall, NISA is considered to have had a positive impact from the perspective of reduced summerfallow acreage.

Summerfallow Cultivation Practices

A reduction in the number of times that summerfallow fields were cultivated was considered to be positive, primarily in terms of potential reduction in soil erosion.

NISA influenced farmers to decrease their number of cultivations in 1 of the 13 study areas where summerfallowing was practised. Apparently, NISA had no effect on summerfallowing cultivation practices in the other 12 soil zones. However, less than 1% of the producers in this soil zone indicated that NISA influenced their decisions on cultivation. Overall, NISA appeared to have a negligible impact inasmuch as frequencies of cultivation changed in only one soil zone and in that instance, there was a slight decline.

Riparian Zones

Riparian zones are bands of vegetation associated with stream/river banks. While riparian zones usually include a minor proportion of the overall landscape, they are more productive in terms of plant and animal biomass than the overall landscape and are a critical source of biotic diversity within the ecoregion (Thomas et al. 1979).

An increase in riparian zone width as a result of NISA influences on farming practices was considered to produce positive environmental impacts, while the converse produced negative impacts.

NISA had a positive influence on riparian zone width in 5 of 16 study areas (primarily Ontario and the Atlantic provinces) and a negative influence in 4 zones, all in the Prairie Provinces. The proportion of farmers who indicated a NISA-related influence to decrease or increase riparian zone width was small (never more than 4% of the producers with riparian zones, except in Saskatchewan soil zone A2, which had 6%). Thus NISA was considered to have a neutral to slightly positive impact on riparian zones in eastern Canada and neutral to slightly negative impacts in western Canada.

Field Margins

As field margins (i.e., borders of natural vegetation surrounding cultivated fields) are reduced or eliminated, so too are the remaining small portions of habitat for resident wildlife and for those species that rely upon these margins as travel corridors between habitats. A

decrease in field margin widths was considered to be a negative impact based on the potential for reduced wildlife habitat and increased soil erosion.

Overall, NISA influenced more farmers to decrease their field margins than to increase them in 6 of 16 study areas. Moreover, in the Prairie soil zones, 3 study areas had net declines in field margin widths. Inasmuch as we had invoked a zero-tolerance for upland habitat loss within the Prairie Provinces, we deemed the impacts of NISA on field margins to be negative in Canada and mitigation measures are necessary such that NISA will not encourage further upland habitat loss in these areas.

NISA also influenced producers in Ontario and PEI to reduce their field margins. However, because less than 2% of these producers were influenced by NISA to reduce their field margins, and because field margins in these areas were not identified in the initial scoping as critical or sensitive areas, we propose that the immediate (1991-1992) influence of NISA in these areas was negligible on wildlife. However, if NISA continues to influence field margin depletion in these areas, the cumulative impacts on wildlife could become more substantial.

Wetland Margins

Wetland margins, the bands of natural vegetation surrounding wetland basins, provide critical nesting cover for waterfowl and other avian species, as well as important habitat for other wildlife. In agrarian settings, these margins also buffer wetlands from nutrient/toxin loading and sedimentation from adjacent croplands.

As farming practices encroach on wetland margins, the functional value of the wetlands to numerous wildlife species is seriously degraded. In fact, wetland basins that have had their margins destroyed by cultivation are of limited value to most wildlife species. Taking a conservative approach, we equated the loss of wetland margins with a loss in wetland function. Therefore, as outlined in section 3.5.1, a zero-tolerance level was invoked in assessing the impact of NISA on wetland margin degradation as well as wetland drainage; any decrease in wetland margin widths would be deemed a negative impact in terms of water quality (increased sediment and chemical loading) and reduced wildlife habitat.

Apparently, NISA influenced farmers to reduce wetland margins in only 1 of the 16 study areas, increase them in 6 areas and had no influence in the balance of study areas. However, in the soil zones where farmers were influenced, the number of farmers who claimed that they were influenced by NISA was relatively small, ranging from less than 1% to 3%. Hence, the impacts on wetland margins overall was small yet positive for 6 areas. Nonetheless, inasmuch as a zero-tolerance threshold was established for wetland margin degradation, the reduction in wetland margin width was deemed negative in one study area.

Wetland Drainage

Wetlands have a multitude of functions ranging from flood prevention and soil moisture enhancement to the provision of wildlife habitat (Environment Canada 1991). Canada has a policy that states that further wetland loss is undesirable and thus NISA-related wetland losses would clearly be deemed a negative impact.

Overall, NISA influenced farmers in 12 of 16 study areas to drain one or more of their wetlands during the first two years of the program. Although the numbers of farmers influenced by NISA to undertake this drainage were small (1-5% per soil zone), any wetland loss exceeded the zero-tolerance threshold. Therefore, it appeared that NISA had a negative impact on wetland basins in Canada during the first two years of the program.

Grasslands

The assessment of NISA-related influences on grasslands relied upon determination of changes in acreages of grasslands (Question 1 of the questionnaire) as an indirect indicator of direction of impact.

Analyses of the survey data revealed that areal coverage of grazed grasslands for NISA only participants increased in 8 of the study areas and decreased in 8 areas (Table 5.2.3.12.2). Changes in areal coverage of ungrazed grasslands were somewhat different, with increases on 4 study areas, decreases on 9, and no change on 3 areas. However, due to questionnaire length constraints, the survey was not designed to discern if these changes were influenced by NISA. Therefore, we could not assess whether NISA directly affected these grasslands in Canada. Nonetheless, it seems that NISA did not negatively affect grazed or ungrazed grasslands in 9 of the study areas (i.e., those with no change or with increases in areal coverage between 1990 and 1992). Follow up assessments should attempt to measure if the program is causing a decline in native grasslands, especially in the Prairie Provinces. Indeed, section 3.5.1 provided compelling evidence for the need to conserve the remaining grasslands in the Prairie Provinces.

Woodlands/Shrublands

The assessment of NISA-related influences on woodlands/shrublands relied upon determination of changes in acreages of these lands (Question 1 of the questionnaire) as an indirect indicator of direction of impact.

Analyses of the survey data revealed that areal coverage of grazed woodlands/shrublands increased in 5 of the study areas, decreased in 8 areas and remained the same in 3 areas (Table 5.2.3.12.2). Changes in areal coverage of ungrazed woodlands/shrublands were similar, with increases on 5 study areas, decreases on 8, and no change on 3 areas. However, the survey was not designed to discern if these changes were influenced by NISA. Therefore, we could not assess whether NISA directly affected these woodlands/shrublands

TABLE 5.2.3.12.2

PERCENT CHANGE IN AREAL COVERAGE OF WOODLANDS/SHRUBLANDS AND GRASSLANDS BETWEEN 1990 AND 1992 FOR FARMERS ENROLLED IN NISA ONLY

	BC	ALBERTA					SASKATCHEWAN				MANITOBA			ONTARIO		PEI	N.S.	N.F.
	C2	A1	A2	A3	B's	C2	A1	A2	A3	C2	A3	A4	C2	C1	E1			
WOODLANDS/SHRUBLANDS																		
Grazed	+3	0	-7	-3	+14	+6	0	-9	-8	-4	+2	-1	0	-1	+6	-5	0	-15
Ungrazed	-9	-98	0	+8	-16	0	0	-13	+9	-7	+5	+13	+11	-2	-6	+1	+2	-11
GRASSLANDS																		
Grazed	+3	-1	-2	+2	+3	+16	+3	-4	+14	-7	-4	+2	-1	+3	-1	-9	+6	-20
Ungrazed	-5	+83	0	-50	-17	-19	-17	+18	0	-8	-15	+18	+17	0	-3	-10	+6	-16

in Canada. Nonetheless, it seems that NISA did not negatively affect grazed or ungrazed woodlands/shrublands in 4 of the study areas (i.e., those with no change or with increases in areal coverage between 1990 and 1992). As with grasslands, follow-up assessments should attempt to measure if the program is causing a decline in woodlands/shrublands within the farming communities of Canada.

5.3 CROP SPECIES/LAND USE DIVERSITY

We adopted the Shannon-Wiener Index (Krebs 1989) approach to estimate land use diversity in cropping. The Shannon-Wiener Index (SWI) is essentially a measure of species diversity. It is a function of the probability of two members of the same species being adjacent to each other in a given area; the higher the probability, the more homogeneous the population and the lower the SWI. Because our intent was to measure the homogeneity of land use in regards to cropping, the concept of species as used in the calculation of the SWI was replaced by the actual areal extent of crops in each of the 17 reporting areas. In this context, the SWI was renamed Land Use Diversity Index, or LUDI. LUDI was calculated as follows:

$$-\Sigma p_i * \ln p_i$$

where p_i was the areal extent of various crops within a given reporting area or province as a percentage of the total agricultural land. To estimate the impact of NISA on land use diversity, we calculated LUDI on a provincial basis using Agricultural Census data (Table 5.3.1) , and on a reporting area basis using the actual data from our survey of NISA/GRIP participants (Table 5.3.2). The census data allowed for a more precise calculation of LUDI because it did not aggregate grains and oilseeds into one category, as was the case with the survey results. On the other hand, the census data available to us was reported on a provincial basis which thus aggregates all of the reporting areas within that province. It is expected that the higher LUDI values (> 2.00) will occur in the sub-humid areas of Ontario and/or in southern Alberta where agricultural diversity is known to benefit from irrigation and extensive cattle ranching. Areas such as Newfoundland, where agriculture plays only a minor role in the province's economy would be expected to have low LUDI values (< 1.00). The more temperate sub-humid regions of Quebec and New-Brunswick should have intermediary LUDI values.

LUDI Calculated using Agricultural Census Data (Table 5.3.1)

The calculated LUDI values indicate that the usual grouping of the three Prairie Provinces into one agricultural region may not account for differences in land use diversity. For instance, Alberta's and Saskatchewan's LUDIs (1.97 and 1.91, respectively) are appreciably different from those of Manitoba and Ontario (2.11 and 2.17, respectively). It would appear that Manitoba and Ontario, rather than Manitoba, Alberta and Saskatchewan, should form an agricultural region. The same can be said of Quebec and New-Brunswick. New Brunswick is usually considered along with Nova Scotia, PEI and Newfoundland, whereas

TABLE 5.3.1

LUDI CALCULATED USING AGRICULTURAL CENSUS DATA (RESULTS)

YEAR	PROVINCE									CANADA
	ALBERTA	SASK.	MANITOBA	ONTARIO	QUEBEC	NEW BRUNSWICK	NOVA SCOTIA	PEI	NEW FNDLND	
1971	1.89	1.96	2.12	2.07	1.36	1.23	1.05	1.20	0.94	1.97
1976	1.87	1.71	2.04	2.16	1.37	1.36	1.18	1.26	1.02	2.05
1981	2.11	1.91	2.24	2.20	1.43	1.43	1.28	1.31	0.96	2.08
1986	1.99	1.99	2.09	2.22	1.39	1.41	1.28	1.30	0.88	1.96
1991	1.99	1.98	2.04	2.21	1.36	1.37	1.22	1.26	0.83	2.01
AVE.	**1.97**	**1.91**	**2.11**	**2.17**	**1.38**	**1.37**	**1.20**	**1.27**	**0.93**	**2.01**

TABLE 5.3.2

LUDI CALCULATED USING EMA SURVEY DATA (RESULTS)

Province	Soil	1990 (Before NISA)	1992 (After NISA)	Impact	% Change
Alberta	A1	1.57	1.68	0.11	7.0
	A2	1.68	1.67	-0.01	-1.0
	A3	1.72	1.72	0.00	0.0
	B4	1.77	1.74	-0.03	-2.0
	C2	1.88	1.89	0.01	1.0
	Average	**1.72**	**1.74**	**0.02**	**1.0**
BC	C2	1.92	1.93	0.014	1.0
	Average	**1.92**	**1.93**	**0.014**	**1.0**
Sask.	A1	1.36	1.31	-0.05	-3.5
	A2	1.44	1.42	-0.03	-2.0
	A3	1.51	1.54	0.03	2.0
	C2	1.72	1.73	0.01	1.0
	Average	**1.51**	**1.50**	**-0.01**	**-1.0**
Manitoba	A3	1.34	1.34	0.00	0.0
	A4	1.67	1.71	0.04	2.0
	C2	1.78	1.85	0.07	4.0
	Average	**1.60**	**1.63**	**0.03**	**2.0**
Ontario	C1	1.74	1.65	-0.09	-5.5
	E1	2.02	2.00	-0.02	-1.0
	Average	**1.88**	**1.83**	**-0.05**	**-2.5**
Maritimes	C2	na	na	na	na
	D2	1.78	1.78	0.00	0.0
	Average	**1.78**	**1.78**	**0.00**	**0.0**
Canada		**1.74**	**1.74**	**0.00**	**0.0**

in fact its LUDI (1.37) is closer to that of Québec (1.38). Newfoundland for that matter was distinctively undiversified (LUDI = 0.93) as compared to the other Atlantic Provinces.

The land use diversity indices did not change appreciably between the 1986 and 1991 census periods. This could be considered a first order indication that neither GRIP nor NISA programming in 1991 had an impact on land use diversity.

LUDI Calculated Using EMA Survey Data (Table 5.3.2)

We also completed a similar analysis using the actual survey data collected on a reporting area basis. As discussed above, the data were less aggregated geographically but more so according to crop and land use. Nevertheless, the analysis complemented the above analysis and apparently corroborated its conclusions.

The overall conclusions were the same as for the LUDIs calculated on a provincial basis using the Agricultural Census data; i.e., as of 1992, NISA has had negligible or no impact on land use diversity. However, the LUDIs calculated on a reporting area basis using the survey data (Table 5.3.2) were substantially different from the LUDIs calculated on a provincial basis using the census data (Table 5.3.1). For instance, the LUDIs calculated on a reporting area basis did not indicate that the Atlantic Provinces were less diverse in land use than Ontario and the Prairies. In fact, the survey data from the NISA/GRIP participants indicated that the Atlantic Provinces were more diverse in land use than Ontario and the Prairie Provinces. Also, the LUDIs calculated on a reporting area basis were, overall, less than those calculated using census data.

These discrepancies may be the result of the aggregation procedures used to generate the census data and/or the lumping of all grains and oilseeds into one category as was done in the survey of NISA/GRIP participants (see question 1, Appendix III). We believe it is the latter explanation. The lumping of grains and oilseeds into one survey category probably masked land use diversity, especially in the Prairie Provinces. This would explain the fact that the LUDIs derived from the survey data failed to demonstrate greater land use diversity in the Prairie Provinces than in the Atlantic Provinces.

It should also be noted that brown chernozemic soils (A1) in Alberta were apparently subjected to much land use diversity change attributable to NISA. In this reporting area, LUDI decreased by 7.0% under NISA. These percentage changes were appreciably greater than anywhere else in the country (Table 5.3.2). The fact that the direction of change under GRIP (-) was different than that under NISA (+) was unexplainable. For the time being, and for lack of a better explanation, we considered this disproportionate change in LUDI under GRIP, and NISA, on Albertan A1 soils an artifact of sampling.

6.0 SIMULATION STUDIES TO ASSESS SOIL EROSION

Fiscal and temporal constraints rendered a detailed assessment of the effect of NISA on all environmental components unfeasible. Therefore, it was decided that the environmental assessment would focus on 2 major environmental components: soils and wildlife habitat. The wildlife assessment was provided in section 5.0 as part of the descriptive assessment of the farmer survey data. Additional qualitative assessments were conducted on the effects of NISA on other environmental components such as air quality, water quality and, by inference from water quality, fisheries.

Note an inherent difference between the assessment of NISA's impacts on soil productivity and nonpoint source pollution (NPSP) risk and the assessment of NISA's impact on wildlife habitat. The environmental impact assessment pertaining to wildlife habitat was inferred directly from the surveyed changes in land use attributable to NISA. The environmental impacts pertaining to soil productivity and NPSP risk were estimated by adjusting the survey results according to the long-term soil productivity and NPSP risk trends. EPIC-derived simulations of long-term trends translated the surveyed land use changes into quantitative biophysical estimates of the impacts of NISA on the environment and the sustainability of agricultural systems.

6.1 SOIL EROSION, SOIL PRODUCTIVITY AND NONPOINT SOURCE POLLUTION (NPSP)

Accelerated soil erosion can decrease soil productivity and increase nonpoint source pollution (Power 1987; Hargrove 1991). This negative environmental impact is the result of soil erosion's reduction of the soil's available water holding capacity (AWHC) through an accelerated depletion of topsoil and its inherent clay and organic matter fractions. This usually translates into water-stress for the crop and a concomitant reduction of the soil's ability to produce yield at a given level of input. As the soil is being eroded, nutrients contained in the sediment also wash away, some of which may be transported to neighbouring streams, lakes and rivers. This loading of surface water is referred to as nonpoint-source pollution, or NPSP. In addition, soluble nitrates and phosphates also can be transported by surface runoff, and percolation of the soil solution beyond the rooting zone. As the AWHC of the soil is decreased, the vertical percolation of water and soluble nutrients is increased. The resulting discharge of nutrients to groundwater is also an appreciable contributor to NPSP.

Rates of soil erosion can be estimated on a limited areal basis for particular farming practices by a number of empirical and deterministic models, most of which are, to some extent, related to the Universal Soil Loss Equation (USLE). These rates of soil erosion can then be compared to theoretical tolerable rates of soil erosion, or "T", to determine if they represent a risk to the long-term maintenance of soil productivity and NPSP abatement. These T-values were determined by the USDA's Soil Conservation Service (SCS) in the 1950's and 60's. They are based on theoretical rates of regeneration of the Ah horizon from

the underlying B and/or C horizons. These T values, despite their usefulness, have been criticized for being unrealistic at times and too general in their geographical extent. More importantly, reliable T-values have not been systematically developed for most of Canada's agricultural region. Also, the T-value concept is inherently unscientific in that the models of topsoil regeneration cannot be validated using direct observation because of the geological time-frame required for topsoil formation. Models of soil depletion, on the other hand can be validated using information derived from actual replicated soil scalping experiments.

As an alternative to the establishment of T-values, some researchers have thus proposed that tolerable rates of soil erosion be set according to their impacts on soil productivity and NPSP. The rationale being that if existing rates of soil erosion do not cause an accelerated decrease in soil productivity and/or an accelerated increase in NPSP, they can be deemed acceptable for the time being. To determine which rates of soil erosion, and to which extent soil can be eroded before soil productivity and NPSP abatement are affected, researchers have performed soil scalping experiments. This removal of topsoil is meant to simulate the disappearance of topsoil over time. As an alternative to the physical removal of topsoil, a number of deterministic models also have been developed. The Erosion-Productivity Impact Calculator, or EPIC, is one such model. The model will simulate the impact of an incremental removal of a given layer of soil thickness on soil productivity and NPSP. The rate of soil removal (erosion), in millimetres of soil thickness per year (mm/yr), is a function of the farming practice specified by the user of EPIC. Because EPIC does not allow for the regeneration of the Ah horizon over time, soil erosion will eventually lead to a collapse of the soil's ability to produce biomass and abate NPSP. Depending on the farming system, this may require anywhere from 10 to 1000 iterations (or simulation years) of the model.

To infer the rate of soil erosion and its impact on soil productivity and NPSP abatement for an area the size of southern Ontario required certain information. This included knowing the areal extent of the most prevalent, or at least the most consequential, farming systems and that the associated simulated rates of soil erosion have been obtained from models such as EPIC. These rates, once multiplied by the percentage areal extent (percent of total acreage), gave an estimate of that farming system's contribution to soil erosion, soil productivity decrease and NPSP. Because these farming systems occurred concurrently, the cumulative environmental impact of these farming systems on a given reporting area was the sum of their areal extent multiplied by their respective simulated rates of soil erosion. To calculate the cumulative impact of these farming systems attributable to NISA, we calculated their contribution to the soil erosion before (1990) and after (1992) NISA. We calculated the cumulative impact of seven prevalent and/or consequential farming systems, as influenced by NISA as of 1992, for each reporting area (Table 6.1). These values represent the average erosion rates for the reporting area weighted according to the change in the areal extent of prevalent land uses between 1990 and 1992. They represent the overall cumulative impact of these farming systems as influenced by NISA.

Any increase in agricultural land use will lead to an increase in soil erosion. Assuming a constant amount of agricultural land, the average erosion rate for the reporting area either

TABLE 6.1

CUMULATIVE IMPACT OF SEVEN PREVALENT FARMING SYSTEMS AS INFLUENCED BY NISA AS OF 1992 FOR EACH REPORTING AREA

The cumulative environmental impact of NISA in terms of eroded soil soil thickness per year (mm/yr) due to a change in the areal extent of prevalent land uses attributable to NISA. The critical threshold in years after the begining of the simulation when the stated erosion rate causes a collapse in the soil productivity and nonpoint source pollution abatement is also indicated. Except for continuous and zerotillage corn in Ontario and continuous cereals in the Atlantic Provines, all of the erosions rates associated with the various land uses did not appear to provoke such a collapse within the 400 simulation year period. In this respect, the minimal impact of NISA in terms of mm of eroded soil per year was deemed inconsequential as of 1992, except of course under zerotillage and continuous corn farm systems in Ontario and continuous cereals farm systems in the Atlantic Provinces.

Note:

Land-use 1 = cultivated summerfallow (CSF)
Land-use 2 = continuous cropping of corn, grains and oilseeds (CRP)
Land-use 3 = chemfallow (CHF)
Land-use 4 = zerotillage (ZT)
Land-use 5 = perennial forages (FRG)
Land-use 6 = improved pasture (PAS)
Land-use 7 = range (RNG)

TABLE 6.1

PAGE 2 OF 5

Province/Soil	Land-use	Erosion Rate (mm/yr)	Threshold (years)	Area 1990 (%)	Area 1992 (%)	Erosion 1990 (mm/yr)	Erosion 1992 (mm/yr)	Impact 90-92 (mm/yr)
Alberta/A1	CSF	0.45	> 400	18.57	18.7	0.083565	0.08415	0.000585
	CRP	0.35	> 400	40.42	35.77	0.14147	0.125195	-0.01628
	CHF	0.3	> 400	2.45	2.83	0.00735	0.00849	0.00114
	ZT	0.25	> 400	0	0.63	0	0.001575	0.001575
	FRG	0.2	> 400	3.22	3.54	0.00644	0.00708	0.00064
	PAS	0.15	> 400	2.52	5.69	0.00378	0.008535	0.004755
	RNG	0.1	> 400	27.06	26.67	0.02706	0.02667	-0.00039
							Cumulative Impact	-0.00797
Alberta/A2	CSF	0.3	> 400	8.55	7.09	0.02565	0.02127	-0.00438
	CRP	0.23	> 400	43.43	44.37	0.099889	0.102051	0.002162
	CHF	0.2	> 400	1.56	1.31	0.00312	0.00262	-0.0005
	ZT	0.18	> 400	7.24	12.63	0.013032	0.022734	0.009702
	FRG	0.12	> 400	6.71	8.51	0.008052	0.010212	0.00216
	PAS	0.08	> 400	4.36	4.69	0.003488	0.003752	0.000264
	RNG	0.06	> 400	21	20.46	0.0126	0.012276	-0.00032
							Cumulative Impact	0.009084
Alberta/A3	CSF	0.3	> 400	5.85	5.86	0.01755	0.01758	0.00003
	CRP	0.29	> 400	43.01	42.09	0.124729	0.122061	-0.00267
	CF	0.28	> 400	0.42	0.43	0.001176	0.001204	0.000028
	ZT	0.33	> 400	0	1.41	0	0.004653	0.004653
	FRG	0.2	> 400	15.13	71.07	0.03026	0.14214	0.11188
	PAS	0.15	> 400	9.49	8.91	0.014235	0.013365	-0.00087
	RNG	0.1	> 400	13.29	13.05	0.01329	0.01305	-0.00024
							Cumulative Impact	0.112813
Alberta/B4	CSF	0.8	> 400	7.67	4.35	0.06136	0.0348	-0.02656
	CRP	0.5	> 400	44.81	45.15	0.22405	0.22575	0.0017
	CHF	0.55	> 400	0.48	0.53	0.00264	0.002915	0.000275
	ZT	0.45	> 400	0	0.08	0	0.00036	0.00036
	FRG	0.3	> 400	16.02	17.72	0.04806	0.05316	0.0051
	PAS	0.2	> 400	4.71	6.14	0.00942	0.01228	0.00286
	RNG	0.15	> 400	6.72	6.85	0.01008	0.010275	0.000195
							Cumulative Impact	-0.01607

TABLE 6.1

PAGE 3 OF 5

Province/Soil	Land-use	Erosion Rate (mm/yr)	Threshold (years)	Area 1990 (%)	Area 1990 (%)	Erosion 1990 (mm/yr)	Erosion 1992 (mm/yr)	Impact 90-92 (mm/yr)
Alberta/C2	CSF	1.25	> 400	3.93	3.87	0.049125	0.048375	-0.00075
	CRP	0.8	> 400	31.35	27.77	0.2508	0.22216	-0.02864
	CHF	0.85	> 400	0	0	0	0	0
	ZT	0.75	> 400	0.12	0.09	0.0009	0.000675	-0.00023
	FRG	0.5	> 400	21.98	24.44	0.1099	0.1222	0.0123
	PAS	0.3	> 400	12.72	12.63	0.03816	0.03789	-0.00027
	RNG	0.2	> 400	6.2	7.2	0.0124	0.0144	0.002
							Cumulative Impact	-0.01559
BC/C2	CSF	1	> 400	8.92	7.57	0.0892	0.0757	-0.0135
	CRP	0.8	> 400	31.93	29.83	0.25544	0.23864	-0.0168
	CHF	0.85	> 400	0.19	0.56	0.001615	0.00476	0.003145
	ZT	0.75	> 400	0.85	0.87	0.006375	0.006525	0.00015
	FRG	0.5	> 400	18.06	20.79	0.0903	0.10395	0.01365
	PAS	0.3	> 400	6.81	7.58	0.02043	0.02274	0.00231
	RNG	0.2	> 400	3.06	3.22	0.00612	0.00644	0.00032
							Cumulative Impact	-0.01073
Sask/A1	CSF	0.4	> 400	27.55	28.41	0.1102	0.11364	0.00344
	CRP	0.6	> 400	41.72	42.56	0.25032	0.25536	0.00504
	CHF	0.3	> 400	5.25	2.41	0.01575	0.00723	-0.00852
	ZT	0.23	> 400	14.48	15.05	0.033304	0.034615	0.001311
	FRG	0.15	> 400	0.64	0.66	0.00096	0.00099	0.00003
	PAS	0.09	> 400	0.76	0.8	0.000684	0.00072	0.000036
	RNG	0.07	> 400	22.35	23.13	0.015645	0.016191	0.000546
							Cumulative Impact	0.001883
Sask/A2	CSF	0.35	> 400	22.25	20.71	0.077875	0.072485	-0.00539
	CRP	0.35	> 400	54.25	56.49	0.189875	0.197715	0.00784
	CHF	0.23	> 400	2.33	2.01	0.005359	0.004623	-0.00074
	ZT	0.18	> 400	7.71	11.46	0.013878	0.020628	0.00675
	FRG	0.1	> 400	1.43	2.06	0.00143	0.00206	0.00063
	PAS	0.08	> 400	2.74	2.56	0.002192	0.002048	-0.00014
	RNG	0.05	> 400	7.09	6.76	0.003545	0.00338	-0.00017
							Cumulative Impact	0.008785

TABLE 6.1

PAGE 4 OF 5

Province/Soil	Land-use	Erosion Rate (mm/yr)	Threshold (years)	Area 1990 (%)	Area 1992 (%)	Erosion 1990 (mm/yr)	Erosion 1992 (mm/yr)	Impact 90-92 (mm/yr)
Sask/A3	CSF	0.8	> 400	18.55	17.76	0.1484	0.14208	-0.00632
	CRP	0.88	> 400	54.64	53.59	0.480832	0.471592	-0.00924
	CHF	0.7	> 400	0.73	0.69	0.00511	0.00483	-0.00028
	ZT	0.15	> 400	0.73	4.55	0.001095	0.006825	0.00573
	FRG	0.09	> 400	3.4	5.67	0.00306	0.005103	0.002043
	PAS	0.06	> 400	1.89	1.69	0.001134	0.001014	-0.00012
	RNG	0.03	> 400	3.55	3.09	0.001065	0.000927	-0.00014
							Cumulative Impact	-0.00833
Sask/C2	CSF	2.25	> 400	12.97	10.53	0.291825	0.236925	-0.0549
	CRP	1.7	> 400	43.95	44.91	0.74715	0.76347	0.01632
	CHF	1.75	> 400	0	0.13	0	0.002275	0.002275
	ZT	1.63	> 400	0.35	0.9	0.005705	0.01467	0.008965
	FRG	0.43	> 400	6.69	8.53	0.028767	0.036679	0.007912
	PAS	0.24	> 400	2.34	3.63	0.005616	0.008712	0.003096
	RNG	0.11	> 400	5.78	5.37	0.006358	0.005907	-0.00045
							Cumulative Impact	-0.01678
Manitoba/A3	CSF	0.45	> 400	3.74	4.24	0.01683	0.01908	0.00225
	CRP	0.35	> 400	65.57	65.48	0.229495	0.22918	-0.00032
	CHF	0.33	> 400	0.06	0.09	0.000198	0.000297	0.000099
	ZT	0.22	> 400	6.18	7.94	0.013596	0.017468	0.003872
	FRG	0.12	> 400	7.22	7.49	0.008664	0.008988	0.000324
	PAS	0.07	> 400	2.98	2.76	0.002086	0.001932	-0.00015
	RNG	0.04	> 400	7.36	7.05	0.002944	0.00282	-0.00012
							Cumulative Impact	0.005952
Manitoba/A4	CSF	0.15	> 400	4.81	4.14	0.007215	0.00621	-0.00101
	CRP	0.14	> 400	47.28	45.34	0.066192	0.063476	-0.00272
	CHF	0.13	> 400	0	0.04	0	0.000052	0.000052
	ZT	0.13	> 400	12.57	19.06	0.016341	0.024778	0.008437
	FRG	0.07	> 400	11.1	12.57	0.00777	0.008799	0.001029
	PAS	0.05	> 400	4.82	4.79	0.00241	0.002395	-0.00002
	RNG	0.03	> 400	5.81	5.88	0.001743	0.001764	0.000021
							Cumulative Impact	0.005803

TABLE 6.1

PAGE 5 OF 5

Province/Soil	Land-use	Erosion Rate (mm/yr)	Threshold (years)	Area 1990 (%)	Area 1992 (%)	Erosion 1990 (%)	Erosion 1992 (%)	Impact 90-92 (mm/yr)
Manitoba/C2	CSF	0.9	> 400	9.17	9	0.08253	0.081	-0.00153
	CRP	0.58	> 400	42.21	38.78	0.244818	0.224924	-0.01989
	CHF	0.63	> 400	0	0	0	0	0
	ZT	0.21	> 400	0	0.9	0	0.00189	0.00189
	FRG	0.12	> 400	11.15	12.47	0.01338	0.014964	0.001584
	PAS	0.09	> 400	2.46	4.12	0.002214	0.003708	0.001494
	RNG	0.06	> 400	7.99	7.89	0.004794	0.004734	-0.00006
							Cumulative Impact	-0.01652
Ontario/C1	CRP	8.18	< 100	52.42	53.89	4.287956	4.408202	0.120246
	ZT	5.81	< 150	1.76	2.37	0.102256	0.137697	0.035441
	FRG	1	> 400	11.13	9.67	0.1113	0.0967	-0.0146
	PAS	0.7	> 400	3.63	3.75	0.02541	0.02625	0.00084
	RNG	0.4	> 400	3.81	3.92	0.01524	0.01568	0.00044
							Cumulative Impact	0.142367
Ontario/E1	CRP	8.18	< 100	22.43	22.55	1.834774	1.84459	0.009816
	ZT	5.81	< 150	9.19	10.13	0.533939	0.588553	0.054614
	FRG	1	> 400	19.36	19.23	0.1936	0.1923	-0.0013
	PAS	0.7	> 400	14.85	15.35	0.10395	0.10745	0.0035
	RNG	0.4	> 400	10.8	10.71	0.0432	0.04284	-0.00036
							Cumulative Impact	0.06627
Atlantic Provinces/C2	CRP	na		na	na	0	0	0
	ZT	na		na	na	0	0	0
	FRG	na		na	na	0	0	0
	PAS	na		na	na	0	0	0
	RNG	na		na	na	0	0	0
							Cumulative Impact	0
Atlantic Provinces/D2	CRP	19	< 150	10.12	7.37	1.9228	1.4003	-0.5225
	ZT	7.5	> 400	1.65	2.02	0.12375	0.1515	0.02775
	FRG	1.2	> 400	4.68	5.01	0.05616	0.06012	0.00396
	PAS	0.98	> 400	2	2.25	0.0196	0.02205	0.00245
	RNG	0.3	> 400	3.26	3.53	0.00978	0.01059	0.00081
							Cumulative Impact	-0.48753

increased or decreased according to the relative change in the areal extent of land uses differing in their contribution to soil erosion. If the shift was from a highly erosive land use such as cultivated summerfallow, to a more conservation-oriented land use such as zerotillage or improved pasture, the average erosion rate for the reporting area and the cumulative impact reported in Table 6.1 decreased. If the shift was from a conservation-oriented land use such as grassland/pasture, to a more erosive land use such as chemfallow, or even zerotillage, the cumulative environmental impact in terms of soil erosion increased. This type of analysis points to the fact that a mere increase in zerotillage, for instance, generally considered a means to soil conservation, does not necessarily imply a reduction in the average erosion rate for that reporting area, especially if the increased zerotillage acreage was previously under pasture or grassland. For instance, the bulk of the increase in the average erosion rate of the E1 reporting area in Ontario was attributable to an increase in the acreage of zerotillage (Table 6.1). This does not mean to say that zerotillage in itself will necessarily have detrimental effects on soils, but that for the sake of sustainable agriculture in the E1 reporting area of Ontario, zerotillage should not be sponsored at the expense of pasture, grassland or perennial forages. This applies to all reporting areas, but even more so in Ontario because of the apparent unsustainability of corn cropping in Ontario's E1 and C1 reporting areas.

6.2 SUMMARY AND CONCLUSIONS

Overall, the environmental impacts as calculated in terms of mm of eroded soil per year (mm/yr) for all reporting areas were negligible, representing only a fraction of a mm per year. More importantly, the erosion rates associated with each of the land uses except for continuous and zerotillage corn in Ontario, and for continuous cereals in the Atlantic Provinces, do not appear to pose an immediate threat to sustained soil productivity. The EPIC simulations were continued for over 400 simulation years. Only under a continuous corn farming system in Ontario and under the continuous cereals farming system in the Atlantic Provinces did the soil system collapse; which was after 100 to 150 simulation years, when they ceased to yield crop and biomass (Table 6.1). It can thus be concluded that, except for these cases, small or negligible, increases or decreases in the overall average soil erosion rate of the reporting areas is probably acceptable for sustainable agriculture.

7.0 SYNTHESIS, CONCLUSIONS AND RECOMMENDATIONS

7.1 ASSESSMENT OF ENVIRONMENTAL ISSUES

In the preceding chapters, several lines of investigation were followed in order to assess the environmental impacts of NISA, and to find answers to the specific questions raised in chapter two. The different lines of investigation did not always lead to consistent findings. This in itself should not be surprising because the methodological approaches were so different in each case; but it does point to a need to integrate all the findings and to explain apparent contradictions in a way that permits intelligent conclusions to be reached.

It was felt that the greatest weight should be given to the quantitative analysis of survey data. The conceptual and theoretical description of NISA, and the opinions expressed in the written submissions, were felt to warrant less weight. Somewhere in between in terms of weighting were the simulation studies of soil degradation and non-point source pollution. Hence, our conclusions were generally more in line with the evidence provided directly by program participants.

7.1.1 Risk Management

NISA mitigates the financial consequences of uncertain crop prices and yields. Farmers also attempt to reduce their exposure to these types of risk through crop selection and land management. The survey results, however, suggest that the majority of NISA participants did not view the program as one that would stabilize their income. NISA is a form of self-insurance. Self-insurance requires that financial reserves be of sufficient size before farmers will rely upon the monies accumulated in a NISA account to be a factor in their risk management strategy. The majority of farmers surveyed contributed less than $1,000 per year to their NISA account. During our assessment, farmers' account balances were too small relative to the perceived year-to-year income variation. Under these circumstances, NISA could not be viewed to be a preferred substitute for other self-insurance schemes like an RRSP. In this context, it is not surprising that the vast majority of farmers indicated they did not change their self-protection risk management strategies such as pesticide usage, fertilizer practices or land management. Even if NISA was believed to be an important self-insurance strategy, risk management theory concluded that it is still unlikely that farmers would change the ways they reduce income variability through the use of inputs or production diversification.

7.1.2 Agriculture Diversification and Market Neutrality

A market neutral and strictly decoupled program is not linked to production and/or sales of agricultural products. Furthermore, it is not dependant upon any inputs acquired by farmers. Government contributions to NISA are tied to eligible sales (and/or use) of grains, oilseeds, pulse and edible horticultural crops. Government contributions plus accrued interest constitute the first reserve fund that farmers may withdraw monies from. Withdrawals can

occur when their annual gross margin falls below the previous five-year average. A farmer, in spite of the financial circumstances that allow him or her to withdraw a sum of money, may in fact choose to leave the funds in the NISA account. In effect, the withdrawal is being postponed until the farmer retires. If withdrawals only took place when farmers retire, NISA would be decoupled from production. Conditions written into the NISA contract, however, require that when withdrawals can occur, the monies must be taken from the NISA account if the balance exceeds eligible crop sales. Forced and voluntary withdrawals prior to retirement are linked to past production and current financial conditions. Therefore, in any year, some of the retirement withdrawals will be decoupled while the rest are based on historical production and current financial conditions.

Because NISA contributions are tied to eligible sales of grain, oilseeds, pulse and edible horticultural crops, it has the potential to influence the livestock sector in two ways. First, if the self-insurance reserve accumulated in the NISA account is viewed by farmers as an adequate revenue source to reduce risk, they may reduce the livestock enterprise when livestock are viewed to be a relatively more costly way to stabilize farm income than using a NISA account. In these cases, farmers will specialize in more grain production and less livestock. However, no evidence was presented that indicates this is happening.

Secondly, if the financial assistance available to livestock is relatively less than NISA, these enterprises could be reduced. The livestock sector potentially receives stabilization support from the tripartite agreements and through supply management programs. Indirectly, forage production does receive some program support. The issue is one of relative support through the array of commodity specific programs and policies. Clearly a whole farm income stabilization policy extended along the structure of NISA has the potential of being more market neutral than the set of current commodity-specific programs. NISA, by being restricted to just grains, oilseeds and horticultural crops, does not appear to have influenced forage production.

7.1.3 Land Use

The NISA agreement does not require or even suggest preferred crop management strategies. Contributions to a NISA account have no bearing upon the crop varieties grown, fertility system followed or pest management strategies implemented. Farmers have the same incentives to self-protect their income through managing inputs as they had without a NISA account. The moral hazard of influencing an unwarranted withdrawal from the account is minimized because the funds removed today are not available when a farmer decides to close the account. As a form of self insurance, the funds on deposit are a buffer to offset low income events. With the security of the financial reserve, some farmers may be more willing to use innovative crop production systems that have the potential of lowering income during the learning phase. This decision, however, must be weighed against a potentially lower amount of money available upon retirement. Therefore, NISA is not biased against low input agriculture or organic farming and indeed, could provide the financial security to change from conventional practises.

7.1.3.1 Land Use/Cropping Diversity

Theoretically, a self-insurance strategy such as NISA will substitute, to some extent, for production diversification. When one of the primary motives for production diversification is to reduce farm income variation through, for example a livestock enterprise or off-farm employment, the presence of a relatively sizeable balance in a NISA account may persuade some farmers to specialize. Specialization has a tendency to reduce costs through economies of scale. For example, using several different production practices requires more management time and different types of equipment. The option of drawing upon a reserve established in a NISA account may allow some farms to reduce their costs and increase their income through specialization. The survey results indicated that few farmers increased specialization as the majority of farmers did not believe NISA provided an adequate financial reserve.

Cropping diversity also was evaluated in terms of the actual areal extent of crops in each of the 17 reporting areas using the Land Use Diversity Index (LUDI). The land use diversity indices did not change appreciably between the 1986 and 1991 census periods. This could be considered a first order indication that neither GRIP nor NISA programming in 1991 had an impact of land use diversity. We also completed a similar analysis using the actual survey data collected on a reporting area basis. These data were less aggregated geographically, but more so according to crop and land use. Nevertheless, the analysis complemented the above analysis and corroborated its conclusions. Therefore, with respect to land use/cropping diversity, it seems the NISA agreement had a negligibly small impact.

7.1.3.2 Summerfallow

Summerfallow area was reduced in 11 of the 13 study areas surveyed. Of farmers' surveyed, between 1% and 5% of farmers attributed the reduction to NISA. Reduced summerfallow is considered to be a positive impact on both soil and water quality. NISA did not affect the frequency of cultivation of the land remaining in summerfallow in 12 of the 13 farming areas. Therefore, with respect to summerfallow, the NISA agreement was deemed to be a positive impact in terms of the potential reduction in soil erosion, improved water quality and the provision of more habitats.

7.1.3.3 Marginal Lands and Wildlife Habitat Including Wetlands

Marginal lands are environmentally sensitive because of their biophysical characteristics as wildlife habitat, wetlands, riparian zones, native prairie and/or highly erodible lands. Marginal lands have consistently been vulnerable to development as a result of economic pressures on producers. For example, as of 1990, over 71% of Canada's wetlands have been drained and 82% of prairie wetland margins have been cleared or cultivated for agricultural expansion (Environment Canada 1991). Agriculture Canada has stated that GRIP should not encourage the breaking up of new land at the expense of wetlands, native prairie and other wildlife habitat areas. Moreover, the Federal-Provincial Safety Net Committee stated,

"programs should not encourage cereal production on fragile lands." This was one of the criteria for evaluating safety net programs that the Safety Net Committee developed.

In its 1992 format, NISA provided no disincentives to undesirable modifications in land use, particularly in environmentally sensitive areas. In fact, several Canadian agricultural economists have suggested that Canadian agricultural support programs may encourage farmers to break up marginal lands (Gray et al. 1991). These concerns were echoed by Environmental NGO's, the United States Department of Agriculture and by interviewees from Alberta, British Columbia, Manitoba, Ontario, and Saskatchewan. These concerns were most pronounced in the Prairie Provinces, where the majority of wetlands and the adjoining upland margins have been targeted for protection under the North American Waterfowl Management Plan (NAWMP).

The primary objective of the NAWMP's Prairie Habitat Joint Venture (PHJV) is to protect and enhance 1.5 million ha of waterfowl habitat in Manitoba, Saskatchewan, and Alberta. Interviewees and providers of written briefs from these provinces were concerned that NISA does not discourage farmers from draining wetlands and/or destroying the critical upland margins adjacent to these wetlands. Our survey results revealed that NISA apparently influenced 1% to 4% of the farmers in 12 of the 16 study areas to drain wetlands. Moreover, farmers in two-thirds of the prairie soil zones admitted being influenced by NISA to drain. Farmers in only 1 of the 16 study areas indicated that they were influenced by NISA to encroach upon wetland margins, and the proportion of those influenced was small (<1%). Thus, because NISA encouraged wetland habitat degradation across the country, it is in direct conflict with the Federal Policy on Wetland Conservation, the NAWMP and recommendations of the Federal-Provincial Safety Net Committee. Therefore, NISA had a negative impact on wetlands.

The mail survey also revealed that GRIP influenced farmers in 6 study areas to reduce their upland field margins and in 4 study areas to reduce their riparian zones. In contrast, some study areas reported increases in field margins and riparian zones. The mail survey was not designed to ascertain the influence of NISA on grasslands or woodlands. However, it appeared that NISA did not attribute to the overall reduction of grasslands or woodlands in the majority of study areas. Furthermore, as of 1992, NISA apparently influenced few to convert their perennial crops to NISA-eligible crops. Indeed forage production acreage increased on farms enrolled in NISA. Additionally, the slight trend toward conservation tillage practices and a reduction in summerfallow would be expected to produce benefits for wildlife. Thus, despite some losses of field margin and riparian habitats, there were compensatory increases in habitat in other provinces, coupled with changing land use practices that would suggest that the overall impact of NISA on upland habitat was negative but negligible.

With respect to contractual set aside lands, it is not clear whether NISA influenced these land use practices. Due to the costs of converting wetlands and other wildlife habitat such as woodlots to annual crop production, the economic incentives to continue this trend will

depend directly on prices farmers receive from the marketplace and on the magnitude of ongoing financial support from governments to maintain net incomes in crop production. At present, there is little information on the degree in which NISA affected, or will affect, producer decisions to enrol or cancel existing conservation set aside programs. Therefore, this is an area that needs to be monitored in the years to come. The economic and environmental benefits of alleviating this potential problem could be substantial.

7.1.3.4 Soil Erosion and Non-point Source Pollution

The effect of NISA on soil erosion was assessed through a variety of analyses ranging from examination of farming practices through detailed modelling using EPIC simulations. Summerfallowing, a practice primarily confined to the Prairie Provinces of Canada, is widely considered to have negative implications for soil erosion because the soil is left exposed to the elements. Summerfallow acreage in the Prairie Provinces was reduced by 6% (over 500 000 ha) from 1990 to 1992, and between 1-5% of the farmers in 11 of 13 study areas where summerfallow was practised, indicated they were influenced by NISA to reduce their use of summerfallow.

Farming practices such as conservation tillage or forage crops help to prevent erosion because the residue of former crops or year-round vegetative cover makes the underlying soils less vulnerable to the erosive forces of wind and water. NISA apparently influenced an increase in the use of conservation tillage practices in 10 of 16 study areas across Canada, with expected associated decreases in erosion. Of interest, was the response by farmers in 13 of 16 study areas that NISA influenced them to increase their acreages of forage crops, despite the fact that NISA offers no economic incentives to do so.

Parallel analyses using EPIC simulations revealed that environmental impacts of NISA as measured by mm of soil eroded per year were negligible (a fraction of a mm per year). NISA did not appear to pose a threat to sustained soil productivity or increased non-point source pollution even when farming systems as practised under NISA conditions were simulated for over 100 years.

7.1.4 Chemical Use and Water Quality

Survey data represented the primary source of information relating to water quality. This data indicated that as of 1992, NISA had no appreciable impact on chemical use in Canadian agriculture as < 5% of farmers were influenced by NISA to change fertilizer or herbicide inputs. Hence, it could not be concluded that NISA contributed to contamination of surface or groundwater. Additionally, our long-term EPIC simulations for non-point source pollution revealed no increased likelihood of non-point source pollution in the foreseeable future. Indeed, as a result of decreased summerfallow, increased conservation tillage and increased acreages of forage crops, one could reasonably expect less soil erosion with a concomitant reduction in chemicals entering surface and groundwater. Thus, NISA was considered to have negligible positive impacts on water quality.

7.1.5 Air Quality

Data to determine the implications of NISA on air quality were not available. However, a previous study commissioned by the PFRA aimed at assessing some of the environmental impacts of PFRA's Permanent Cover Program, and in particular its impact on agriculture's carbon dioxide emissions, indicated that land enrolled in PCP could potentially act as carbon sinks. To the extent that carbon dioxide emissions are considered an air quality issue, NISA-related apparent short term benefits associated with conservation farming practices and increased forage acreage could be contributing to storing a portion of the carbon dioxide otherwise emitted by agricultural soils. The whole issue of agriculture as a carbon sink and source has been dealt with in a 1990 (ASA) monograph (Kimball 1990).

7.2 RECOMMENDATIONS/MITIGATION MEASURES

The recommendations contained herein arise from the expectations in the Terms of Reference that recommendations be made based upon the following sub-headings. It is also recognized that the NISA National Committee desires to have input on the final recommendations regarding program review.

7.2.1 Recommendations From Written Submissions

Representatives of Canada's agri-food industry and interest groups submitted briefs regarding the environmental implications of NISA (see section 6.2.1). In some cases the contributors provided suggestions about how perceived short-comings of NISA might be approved. Only seven submissions were received that provided recommendations on changes to NISA.

Inclusion of Forages

Contributors of briefs were explicit about the need to incorporate forage crops under NISA. The mechanics of how this might be accomplished were not stated but rather, the emphasis was on ensuring inclusion of the livestock industry, protection of erosion prone lands and provision of alternative benefits to wildlife.

Inclusion of All Farm Products

Contributors commented on the merits of including all farm products under NISA to make it a "whole farm" program. Specifically, livestock, poultry, tobacco and beans were included in the list of products.

Inclusion of Wildlife

A single Manitoba farmer advocated the concept of determining the value of lands set aside for wildlife habitat and allowing those values to be eligible for NISA.

Incentives for Sustainable Farms

While not explicit concerning the mechanism for this concept, several contributors suggested that special provisions be available within NISA to provide preferential treatment (including incentives) for farmers using "conservation friendly" techniques such as conservation tillage, wetland enhancement etc.

7.2.2 Environmental Cross-Compliance

7.2.2.1 What is Environmental Cross-Compliance?

Use of policy instruments for environmental protection and natural resource management has been increasing throughout the developed world during the past two decades. These instruments fall into three broad categories:

- Information and Awareness
  - extension (technical advice; moral suasion; adoption diffusion)
  - demonstration and pilot projects

- Economic Instruments
  - fiscal incentives (grants, loans, contracts, reduced premiums)
  - product charges (special taxes on phosphate detergents, gas tax)
  - emission charges (fines for pollution)
  - tradable emission rights
  - land use zoning

- Direct Regulation
  - legislation (Canadian Environmental Protection Act)
  - standards and regulations (effluent release, drinking water standards)
  - municipal by-laws (landfill by-laws)
  - land use zoning (no development in floodplains)

Cross-compliance is a policy instrument with features common to the latter two categories. Cross-compliance has been defined as "**an expression denoting incentive or disincentive measures which are used to affect compliance, or harmony, between two or more policies or programs**" (Report of the Federal-Provincial Agricultural Committee on Environmental Sustainability, June 30, 1990).

Environmental or conservation cross-compliance is practised in other jurisdictions, most notably in the United States, Europe and Australia (Cohen et al. 1991, Girt 1992). In the United States, it became prominent with the introduction of the 1985 Farm Bill under which "conservation compliance for highly erodible land", "sodbuster" and "swampbuster" became prominent terms in the lexicon of agro-environmental affairs.

The concept of environmental cross-compliance is not a new one in Canada for that matter. In 1989, Agriculture Canada articulated a vision for Canada's agriculture and food sector, in a discussion paper entitled " Growing Together: A Vision for Canada's Agri-food Sector". That document provided a conceptual framework within which to organize the most comprehensive review of Canadian agri-food policy ever undertaken. Environmental sustainability figured prominently in the ensuing Agri-food Policy Review (APR), especially through the work of the Federal-Provincial Agricultural Committee on Environmental Sustainability.

The "Growing Together" document of 1989 included the following statement as part of its principles for action:

> "All government programs and policies must take into account environmental sustainability in their design and delivery. Compliance with environmental requirements may have to be encouraged." [Page 69]

Subsequent to that document, the "Report to Ministers of Agriculture, Federal- Provincial Agriculture Committee on Environmental Sustainability, June 30, 1990" included recommendations on policy and program reform which included:

> " ... assessing federal and provincial policies and programs to ensure that they are neutral or supportive of environmental sustainability... and ...implementing cross-compliance, by making eligibility for program benefits conditional upon approval of individual farm conservation and waste management plans..."

An example of how environmental cross-compliance might take effect would be specific eligibility criteria for assessing applicants under a particular government program. For example, an applicant would need to file an approved farm conservation plan in order to be eligible to receive government program payments. This approach has been proposed in Alberta and Ontario, has been recently announced as policy in Quebec and is in practice in the United States.

7.2.2.2 NISA and Cross-Compliance

During drafting of the Farm Income Protection Act (FIPA) as well as the Federal-Provincial agreements under which NISA took effect, there was uncertainty regarding the environmental performance of NISA and therefore environmental clauses were inserted. These clauses included "**...define the circumstances and conditions under which insurance [program benefits] may be withheld, restricted or enhanced for the purpose of protecting the environment...**" [FIPA section 5 (2) (a)].

The Federal-Provincial Agreement establishing the Net Income Stabilization Account Program (NISA) also states:

"Within two years of the Agreement coming into effect, Canada and the Provinces agree to complete an environmental assessment report ... on the need for amendments to the Plan, mitigation measures, cross-compliance and environmental regulations as the case may be."

7.2.2.3 The U.S. Experience With Cross-Compliance

As previously described, environmental cross-compliance relating to farm assistance programs in the United States arises from the conservation provisions contained within the 1985 Food Security Act and the Food, Agriculture, Conservation and Trade Act of 1990. There is an abundance of literature which reviews cross-compliance successes and shortcomings (e.g., Cook et al. 1992, Girt 1992, Zinn 1991, Cook and Art 1993, Miranowski and Anderson 1993). Rather than repeating this information here, the reader is directed to the above-described literature.

In an effort to obtain the most current impressions of the U.S. experience with cross-compliance and farm assistance, EMA scientists consulted with key agricultural and environmental agency representatives at meetings in March, 1993 in Kansas City, Missouri (Soil and Water Conservation Society - "The Next Generation of U.S. Agricultural Conservation Policy", March, 1993) and in Washington D.C.. These meetings with over 70 individuals from over 30 agencies were designed to assess the U.S. experience and ascertain what elements of cross-compliance could be potentially applied in a Canadian context. The results of those interviews are summarized below.

What is working now

- Graduated penalties where the landowner is fined in a proportion commensurate with the magnitude of the contravention. This provides some protection from being over-penalized for inadvertent acts of non-compliance.

- Graduated penalties make it easier for Soil Conservation Service (SCS) personnel to report violations, and for Agricultural Stabilization and Conservation Service (ASCS) to impose penalties.

What doesn't work

- Inconsistent evaluations of contraventions because of SCS personnel being concerned about compromising their relationships with landowners with whom they have developed farm conservation plans. The analogy of the SCS having to wear both a black hat and a white hat was consistently cited; this is widely recognized as being a problem.

- SCS personnel are spending far too much time on compliance evaluation work rather than on their original mandate of information extension, that is, developing and helping to deliver conservation planning.

- Compliance evaluations occur only at one time whereas soil erosion problems may occur at various times of year. For example, a compliance inspection might occur only in the spring, whereas soil erosion problems also occur during other seasons.

What could be improved

- Pro-rated penalties for minor infractions after the first contravention rather than losing all farm program monies regardless of the magnitude of the second contravention. This would make the SCS agency personnel and farmer relationship better. However, there is a recognition that habitual offenders must be dealt with harshly.

- Off-farm considerations relating to environmental degradation needs to be addressed, e.g., effects of agricultural runoff on receiving waterbody water quality

Landowner receptiveness

- Little quantitative information on landowner receptiveness to cross-compliance has been collected. One of the few studies in this regard did, however, reveal that on highly erodible land (HEL), approximately 53% of U.S. farmers were complying with conservation plan implementation (Esseks et al. 1993). However, among those farmers with conservation plans, 27% indicated a desire to change those plans and 32% needed clarification on when conservation practices should be applied. A full 47% of the farmers interviewed indicated that they did not intend to comply with conservation compliance initiatives on highly erodible land. A study of Iowa farmers (Padgitt and Lasley 1993) found that farmer support varied with time. Support grew for a short time after conservation compliance legislation was introduced in 1982, reaching a peak of 72%. In 1991, 2 years after implementation, farmer support was near 60%, more than twice the number expressing opposition.

- Cook and Art (1993) revealed that an extremely small fraction of U.S. farms receiving farm assistance benefits were found to be in violation of resource compliance provisions relating to "sodbuster" (HEL violations) and "swampbuster" (wetlands conservation violations). In 1991 for example, the year with the most violations, only 0.05% of the 1.5 million farms that participated in farm assistance programs were penalized for conservation non-compliance. Since 1986, only 2,499 farms have been denied farm benefits because of non-compliance. However, 45% of these farms have had their benefits reinstated. ASCS data revealed that 394 and 156 producers were found in violation of sodbuster and swampbuster provisions, respectively, in 1992 (ASCS, unpublished data). The issue here is not

one of apparent widespread acceptance by farmers of the conservation compliance requirements but rather, that SCS and ASCS are doing an inadequate job of reporting violations and monitoring compliance (United States Department of Agriculture 1992). Thus the degree of acceptance of conservation compliance is difficult to gauge.

Administrative/Logistical Considerations

- Creating a new environmental compliance division in USDA would separate enforcement from conservation planning delivery but there would be some duplication of personnel and additional costs. Furthermore, the compliance monitoring personnel would also need to understand the complexities of conservation plans (like the current SCS personnel), not just enforcement issues.

Costs

Discussions with ASCS personnel in Washington, revealed that in 1992, $21 million was spent on activities relating to monitoring of cross-compliance with respect to Highly Erodible Land and wetlands.

7.2.2.4 Considerations for Implementation of Cross-Compliance in Canada

Background

Government interest in the environmental sustainability of farm programs was manifested in the report by the Federal-Provincial Committee on Environmental Sustainability to the agricultural ministers of Canada where a recommendation was made to investigate the feasibility and acceptability of cross-compliance measures in agricultural programs (Agriculture Canada 1990). Indeed, as was described in section 7.2.2.2, legislation relating to the enactment of NISA requires that program delivery be tied to environmental protection measures (cross-compliance). This interest prompted Agriculture Canada to commission a study to review the feasibility of implementing cross-compliance measures for provincial and federal programs in Canada (Girt 1992).

This interest in cross-compliance has been, to a considerable degree, motivated by an electorate concerned about public monies being allocated to farm support programs with real or perceived environmental liabilities. Esquirol (1991) and various speakers at the Soil and Water Conservation Society Conference in Kansas City in March, 1993 questioned how much longer the non-farm public will accept these expenditures without some sort of accountability in terms of prudent use of our soil, air and water resources.

There is growing evidence that the farming community in Canada is interested in environmental degradation issues. Kreutzwiser and Pietraszo (1986) reported that over 80% of landowners in Ontario recognized the need for wetland protection. Amongst landowners

in rural southern Saskatchewan, Young and Thompson (1990) reported that 76% of the population favoured protecting and reclaiming wetlands. Duff (1991) reported that 86% of farmers in an erosion-prone area of Ontario considered soil erosion to be a problem.

Further evidence of this exists in the recent efforts by a coalition of farm organizations in Ontario who formed Ontario's Farm Environmental Agenda to address the maintenance of environmental integrity on Ontario farms. In the County of Stettler in Alberta, a Pilot Study to evaluate implementation of soil and water conservation plans at the Municipal Government level revealed that 53% of farmers acknowledged the occurrence of wind and water erosion (Young et al. 1992). Further, when questioned about their thoughts on the need for conservation programs, 10% indicated there were already too many, 64% indicated there was an adequate number and 26% suggested there were not enough. On the matter of the value of coordinating consistent implementation of soil and water conservation activities, 84% responded that this would be a good idea. With regard to who should administer and deliver such programs, 53% indicated an association of local landowners and local government, 38% indicated the County and Agricultural Service Board, 16% suggested the Province of Alberta and 5%, the Federal Government.

Given the apparent widespread recognition of the seriousness of environmental degradation on the farm, why is the farmer generally reluctant to embrace conservation programs? This really becomes the heart of the discussion regarding the potential acceptability of cross-compliance measures to achieve environmental protection. There are multiple reasons for this. For example, some aspects of soil degradation (e.g., organic matter loss) occur relatively slowly and are not as visible as, for example, weed infestations. Secondly, and perhaps more importantly, soil conservation has few, tangible short-term benefits for the landowner. Put simply, when moisture conditions and commodity prices are good, the landowner perceives few problems. However, when the opposite is true, the landowner is under too much economic duress to adopt sometimes costly conservation practices which do not have immediate economic benefits.

> *"Though a landowner may be cognizant of the societal or external values of wetland habitats, such concerns are usually preempted by his on-farm costs and benefits when the fate of a wetland is being considered. These habitats rarely convey any tangible benefits to the landowner, but instead represent an impediment to increased production and the source of higher operational costs."*
>
> *From: Turner et al. (1987)*
>
> *"Overcoming soil deterioration is one of the greatest challenges that must be met if the future of the Canadian agriculture and food sector is to be assured. The need to succeed in this area is even more important at a time when financial problems cause many farmers to pay less attention to long-range planning. Coordinated action by farmers, public authorities and non-government agencies is therefore required..."*

From: A National Agricultural Strategy
(Ministers Responsible for Agriculture 1986)

More fundamentally, conservation measures and conversely, activities such as wetland drainage and cultivation of marginal land incur real or perceived costs and benefits that are not equally allocated between the farmer and the non-farming public.

These costs and benefits are allocated to either society as a whole or to the landowner as an individual. Concerns have been raised that farm-related subsidies, government-sponsored drainage and cultivation of marginal lands are supported by public taxes, with benefits being realized by the landowner. Similarly, the costs of remedial measures such as erosion control and flood prevention structures are generally borne by society and downstream users, and not by the landowner on whose land problems originate (Leitch 1981, Phillips and Veemen 1985, Fuller 1987, Federation of Ontario Naturalists and Environment Canada 1987). Furthermore, these costs are difficult to quantify, unlike the benefits of increased agricultural production (Bardecki n.d., Leitch 1981, Manning et al. 1988), or even increased quota entitlement, both of which directly benefit the landowner.

Conversely, if the farmer chooses to conserve wetland or upland habitat, he/she may forego economic benefits and furthermore, may incur costs such as waterfowl crop depredation. At the same time, society as a whole accrues benefits from the values associated with maintaining that habitat, examples of which include flood protection and recreational opportunities.

The difficulty lies in determining how the cost of supplying benefits can be allocated. If the landowner is expected to manage a valuable resource such as wetlands which produce broad societal benefits, then society will need to consider a means of compensating the landowner for providing those benefits. Similarly, society may justifiably ask that public funds not be spent on activities such as wetland drainage which produces primarily on-farm benefits while compromising a resource which otherwise provides benefits to the public.

Recommendations for Cross-Compliance in Canada

Among other things, the Girt (1992) study revealed that the concept of cross-compliance was being contemplated in Canadian jurisdictions including Prince Edward Island (PEI 1990) and Ontario. Hilts et al. (1989) also reviewed the acceptability of this concept on a National basis. Most recently, Quebec has adopted cross-compliance measures which include the requirement for farm conservation plans to become eligible for farm support monies (Belzile 1993).

Based on the Girt (1992) study, coupled with our evaluation of the U.S. experience and consultations in Canada, the following recommendations for implementation of cross-compliance in Canada are presented.

- As a precursor to environmental cross-compliance establishment, a clear set of environmental objectives needs to be established at both the National, Provincial and/or agroecological levels. For example, targets should be set for: (1) numbers and types of wetlands that need to be protected as part of a broader strategy to conserve and enhance wetlands within the agricultural zone of Canada; 2) maximum nitrate contamination levels of groundwater; and 3) maximum rates of soil loss. This follows on the lines of threshold value establishment.

- The semantics or the way that cross-compliance is described influences the palatability of the concept. Cross-compliance need not take the form of regulations for which there is often intense opposition. Examples of this include the U.S. "sodbuster" and "swampbuster" provisions where benefits are denied for not complying with established environmental protection objectives. Rather, they could be more positive or incentive-driven whereby program benefits could, for example, be enhanced in return for environmental protection measures contained in farm conservation plans such as wetland preservation or zerotillage (see section 8.2.3.3). Lynch-Stewart et al. (1993) described how Canada is noted for use of policy rather than regulation to achieve wetland conservation, but that certain provinces including Prince Edward Island, New Brunswick and Quebec have either implemented or are contemplating wetland and other habitat protection legislation. Given the identified degradation of wetlands as a result of GRIP, there are compelling reasons to consider regulatory measures comparable to "swampbuster" in Canada to slow or halt the loss of this dwindling resource.

- Farm conservation plans with clearly defined environmental objectives should be required on a broader basis across Canada. The Provinces of Ontario, Quebec and Alberta are already requiring and/or delivering such programs. These should be more broad-ranging or holistic (referred to in U.S. as total resource management or whole-farm conservation planning) for each farm enrolled in subsidy programs (Bridge 1993). These measures should not be confined to just soil conservation activities on erodible lands but also waste management and avoidance of wetland degradation. Implementation of a policy for conservation plans should be phased in over several years.

- If adoption of cross-compliance on all farms receiving subsidies was impractical, the concept should be introduced for Class IV-VI lands or threatened ecosystems, similar to what is required in the U.S. for Highly Erodible Lands.

- Achieving maximum success in implementing conservation measures will occur when the farmer endorses the concept. However, support in the form of training and technical advice will be required. This should include an extension of existing programs but there must be a recognition that the workload for existing personnel would be substantially increased if all farms are to be incorporated into this exercise. The monitoring component itself will consume considerable time.

Establishing an administrative infrastructure to address compliance evaluation would be costly. Furthermore, whether the responsibilities of program delivery and compliance monitoring could be addressed by the same agency must be explored given the existing difficulties in this regard in the U.S.

- A monitoring framework will need to be established to evaluate performance with respect to achieving environmental protection objectives.

- Cross-compliance in relation to NISA implies a need to evaluate compliance. The data collected for such a purpose will need to be exhaustive to ensure complete coverage of all program participants. If such was not the case, individual farmers could rightfully challenge the compliance evaluation on the basis that their farm was not properly assessed. Exhaustive areal coverage of all program participants ensures that all program participants be treated equally before the legislation enacting cross-compliance. This suggests that techniques suitable for examining broad areas be applied. This would likely occur through remote sensing, coupled with some ground-truthing.

7.2.3 Delivery of Cross-Compliance Under NISA

A comparison study of the environmental effects of GRIP reviewed how cross-compliance measures could be tied to withholding, restricting or enhancing crop insurance under GRIP. For NISA, the government component of contributions to NISA accounts could be made conditional upon addressing environmental criteria. This section of the document outlines some examples of how these provisions might be applied to NISA in order to comply with the wording of the legislation and agreements.

7.2.3.1 Withholding NISA Contributions

For example, government contributions could be withheld under any of the following circumstances or conditions:

- failure to develop and then begin implementation of an approved farm conservation plan within specified periods of time after enrolment in NISA;

- violation, by the applicant, of contractual terms for conservation programs such as the Permanent Cover Program (PCP), the North American Waterfowl Management Plan, whether they be administered by Federal, Provincial, or Municipal governments or private agencies;

- degradation through draining of wetlands, cultivation of grasslands or clearing of woodlands that are designated by Provincial or Federal Governments as being of environmental significance;

- failure to comply with fertilizer application recommendations derived from soil tests and analysis at a registered laboratory;

- upon conviction under any Federal, Provincial or Municipal legislation, regulation or by-law regarding environmental protection (e.g., exceeding manure effluent standards) or resource conservation;

- insurance would be withheld for the year within which the disqualifying activity occurred;

- re-instatement could occur conditional upon the applicant furnishing acceptable evidence of corrective action, compliance with stated laws, and possible restitution for damages incurred.

7.2.3.2 Restricting NISA Contributions

Government contributions could be restricted under any of the following circumstances or conditions:

- the NISA enrollee grows an annual crop on Canada Land Inventory (CLI) lands designated as having agricultural capability classes IV, V or VI;

- the NISA enrollee grows an annual crop on lands formerly designated as wetlands;

- the NISA enrollee grows an annual crop on highly erodible soils, regardless of CLI classification for agricultural capability, as determined by local or regional soil conservation authorities;

- the NISA enrollee grows an annual crop on lands designated as being environmentally sensitive (e.g., unique feature), as determined by local or regional conservation authorities;

- **except**, no restriction would apply for the applicant who provides acceptable evidence of implementation of a locally or regionally approved environmental protection plan for such lands.

7.2.3.3 Enhancing NISA Contributions

With this approach, government contributions could be enhanced under any of the following circumstances or conditions:

- the NISA enrollee files a locally or regionally approved farm conservation plan which includes provisions such as contour plowing, grassed waterways etc.;

- the NISA enrollee furnishes proof of implementation of habitat protection or enhancement measures such as retention/creation of wetlands and/or upland habitats such as woodlands or grassland nesting habitat;

- the NISA enrollee furnishes proof of habitat protection measures for rare/endangered species;

- the NISA enrollee provides evidence of wildlife depredation of farmlands as these lands are clearly providing wildlife habitat;

- the NISA enrollee furnishes proof of waste management practices such as manure containment facilities, pesticide storage and handling procedures which contribute to the protection of surface and groundwater quality;

- the NISA enrollee furnishes proof of use of recognized but non-conventional or alternative production systems and practices for eligible crops in designated areas, examples of which include:

  - minimum till, no till, zero till, ridge till
  - organic farming according to Provincial or industrial standards
  - enrolment in an integrated pest management and/or fertilizer management program

7.2.4 Alternative Options

The above-described discussion regarding cross-compliance does not represent the only alternative to achieving sustainable agricultural objectives. Other options exist including continuation or expansion of ad hoc programs or outright modifications to the GRIP program.

7.2.4.1 Ad Hoc Measures

Although not an exhaustive list, some of the measures that could be considered include:

- Continuation and expansion of educational programs

- Provide ad hoc incentives for protection of specific environmental resources such as wetlands or rare/endangered species with the intent of communicating that these are assets on the farm rather than liabilities

- Promote multi-agency cooperation such as that under the North American Waterfowl Management Plan - Prairie Care Program to achieve soil conservation and wildlife habitat benefits

- Modify programs such as the Permanent Cover Program (PCP) to further enhance wildlife habitat. For example, haying or grazing allowed on these lands might have certain conditions attached such as timing and intensity of those activities (e.g., delayed haying, rotational grazing). Additionally, PCP and other programs such as the Land Management Assistance Program could be extended to provide further assistance to farmers for shelterbelt and woodlot development.

7.2.4.2 NISA Program Changes

NISA is a risk management strategy that accumulates financial reserves. Generally, farmers did not perceive the program as a risk management strategy as their 1991 financial reserves were insufficient to buffer most income reducing events. As long as the NISA account balance remains low relative to the annual variation in the farm's possessive gross margin, farmers will tend to view NISA as an inferior risk management option.

For the farmers who believe NISA to be a preferred means of accumulating financial reserves, it will take a number of years before the account has a sufficient balance to represent a viable contingency plan. Over two-thirds of the remaining farmers rank NISA below other investment/savings alternatives. For this group, their NISA account will grow at even a slower rate. Some indicated they planned not to contribute to their NISA account and close it at the earliest opportunity.

NISA could become a primary risk management program if the annual contributions were larger and/or withdrawals could exceed the account balance. Increasing the annual contributions eligible for matching government monies would increase the account balances more rapidly. The incentives of the added contributions and larger balances will persuade some farmers to rank NISA as a preferred investment/savings alternative. The matching amount necessary to entice added contributions will vary according to the financial circumstances of the farm, income variability and the cost of other risk management strategies.

The alternative of allowing a negative balance in the NISA account accomplishes the stabilization objective of the program without contributions occurring over a number of years. Operationally, the conditions of withdrawal do not change. However, when the NISA balance is less than the eligible amount to be withdrawn, the farmer must borrow from the financial institution holding the account. Repayment of the NISA deficit is contingent upon future eligible contributions. The annual individual deposit plus the government matching monies will be used to retire the debt in the individual's NISA account. Obligations for repaying the debt rest with the individual, and personal guarantees are pledged by the individual. If the NISA account has a negative balance when the balance is concluded, it is discharged with all other debts before any equity is realized by the farmer. Therefore, if the financial institution does not believe the individual is an acceptable risk, a NISA account loan will not be advanced. Neither the provincial or federal governments would be liable

for the debt. Their obligations remain the same, namely the matching NISA contributions which would be the same as if the account was in a positive balance.

When a NISA withdrawal is not tied directly to the account balance, new entrants have the same stabilization plan as established farmers. In these circumstances, depending upon the risk exposure, a self-ensuring NISA account may become a preferred strategy to all risk crop insurance, revenue insurance or tripartite stabilization. Every year, a portion of the NISA fund will be withdrawn by retiring farmers. In these cases the program funds are decoupled from production. Remaining payments are related to production. In these circumstances, farmers realize that they are drawing funds from their retirement reserve and should be less inclined to deplete these reserves than a common insurance-type pool of funds.

Excluding some agricultural receipts from qualifying as eligible sales upon which a NISA contribution is made reduces the potential balance in the account. A lower balance diminishes the reserve's capability to provide self-insurance. Whole farm coverage (inclusion of all farm products including forages) would allow farmers to contribute more money toward their NISA reserve. A larger reserve of funds on deposit in the NISA accounts increases the possibility that NISA will replace other risk management options. In the case of crops, this would include all risk crop insurance, revenue insurance in GRIP, and tripartite stabilization for red meats, sugar beets and honey. The net effect upon the environment involves comparing how the decisions of farmers will change when they voluntarily withdraw from these other stabilization programs.

NISA is a form of self-insurance through management of a financial reserve. Funds withdrawn from the reserve are likely to mean fewer funds available upon retirement. Therefore, farmers have the incentive to manage payouts in the context of a reduced retirement annuity. These incentives should result in comparable decisions with respect to input use and crop and livestock production as if there were no stabilization program. Moreover, the environmental performance of a NISA whole farm coverage program would be comparable to a market driven allocation of resources.

NISA provides no incentives or financial encouragement to conserve soil, water and biological resources. As such, it is market neutral with respect to the environmental consequences of farmer decisions. NISA is not capable of correcting market signals which do not reflect the value of maintaining common property resources. Furthermore, NISA would not be well suited to ameliorate these environmental problems. Environmental programs which are more targeted in terms of how they influence farmer behaviour will be more cost-effective than conditional eligibility clauses written into a NISA agreement.

7.2.5 Environmental Monitoring Programs

7.2.5.1 Introduction

The environmental monitoring program for NISA should be aimed at gathering data capable of yielding useful indicators, criteria and thresholds of environmental sustainability. To ensure cost-effective areal coverage of all NISA-influenced areas, we recommend the use of archived and immediate remote sensing imagery. The cost-effectiveness of such imagery, be it Landsat Thematic Mapping (TM) or SPOT (Satellite Pour l'Observation de la Terre), is highly dependant on the size of the areal coverage; remotely sensed data for small areas is not cost effective. Over large tracts of land, remote sensing is by far more cost-effective than aerial photography, let alone farm-by-farm field inspection. Monitoring would most likely involve sub-sampling of broad agroecological areas rather than the entire area within which NISA is administered.

Data gathered for monitoring, modelling and analysis of NISA-induced land use changes and its long-term environmental impacts could also be used for compliance evaluation. However, as environmental monitoring and analysis only requires statistically representative samples, rather than an exhaustive areal coverage, data gathered as part the cross-compliance evaluation effort would need to be more comprehensive to incorporate all NISA participants.

It is important to note that the monitoring of NISA using information derived from remotely sensed TM and SPOT data is not contingent upon the evaluation of cross-compliance. If cross-compliance was deemed too controversial or beyond the budgetary limits of FIPA, monitoring alone, because it is less data intensive, would also be less expensive.

7.2.5.2 Land Use

Julian Dumanski and Margaret Cann from Agriculture Canada's Centre for Land and Biological Resources Research (CLBRR) have proposed a number of land use parameters as indices of environmental sustainability, including;

- Cropping intensity (%): The ratio of land cropped in any one year on the average, to that of physical area in agricultural use.
- Arable land as a percent of total land: An indicator which would show the resource availability of arable land.
- Irrigated land as a percent of arable land: An indicator which would show the resource availability of irrigation as a percent of arable land.

- Growth of gross agricultural production (% per year): When juxtaposed with self-sufficiency ratio, the question *"is agricultural production keeping up with the population growth rate"* is addressed.

- Self-sufficiency ratio (%): This ratio indicates, according to the total agricultural production, whether a country could theoretically support its population without importing.

- Net primary production: This indicator is used as a basis for evaluation the biological performance of a landscape.

- Per capita grain and food production (t per persons): The trend in per capita grain production gives a sense of whether overall food availability is improving or deteriorating.

- Maximum sustainable yield (t per hectare): A variant of the Carrying Capacity model which is designed to prevent the maximum sustainable yield of a given renewable natural resource from being exceeded.

- Cereal production trend: When there is an overall decline in cereal production, it is an indication of a possible food crisis. (This is probably more applicable to Africa than to countries like Canada which export grain).

- Fertilizer and pesticide use and nonpoint source pollution risk: Because of the loss of nutrients and chemicals through surface runoff and leaching beyond the rooting zone, their use can be used as an indicator of NPSP risk.

- Crop yield and soil productivity trends: Long-term crop yield estimates, once adjusted for increased or decreased inputs, are a necessary measure of the inherent soil productivity. Accelerated rates of soil productivity loss are an indication of potentially irreversible soil degradation.

This list relates primarily to land use and input use, and does not include either discipline-specific environmental indicators or threshold values for these disciplines. A more comprehensive discussion in that regard is thus presented below.

7.2.5.3 Soil Degradation and Non-Point Source Pollution

The environmental monitoring program for NISA should be focused toward collecting quantitative data which can be used to assess change. The survey that was completed as a component of this study is indicative of the kind of information that is required from a monitoring program. It is likely not possible to find a single measurable parameter that can be used to evaluate environmental sustainability. Instead, monitoring should focus on collecting accurate and relevant biological, physical and chemical data along with land use

practice information so that the information can be used to track changes in calculated indicators. The indicators are not measurable parameters, such as soil erosion, but calculated parameters based upon linkage models such as EPIC or simple ratios. What is imperative before any monitoring plan is developed is that the indicators, criteria and thresholds which are intended to be used to evaluate environmental sustainability be developed first.

Experience gained from this evaluation suggests that models like EPIC are very good integrators of information that can produce relevant information to use as indicators. However, the models are only as good as the information they use and a significant component of any NISA monitoring program should include monitoring of parameters which drive EPIC and/or other environmental models.

Also, the analysis of the trends and thresholds generated by EPIC has a lot of potential merit in regards to the estimation of the environmental effects, positive or negative, of various prevalent land use systems such as chemfallow, zero-tillage and continuous cropping.

Because of budgetary and time constraints associated to the present study, such analyses could only be done qualitatively (Table 7.2.1). This has severely limited our ability to assess the environmental impacts of the changes in the areal extent of these land use systems attributable to NISA.

7.2.5.4 Wildlife Habitat Changes

The impacts of NISA on wildlife habitat need to be monitored for both terrestrial and aquatic (primarily wetland) habitat. As previously described, we had established a zero-tolerance threshold for wetland loss in conformance of stated Government of Canada policy (Government of Canada 1991a). Adopting this approach, monitoring of wetland degradation to determine exceedance of this threshold could be a relatively simple task involving only the demonstration that a single wetland had been affected.

In practical terms, it will be important to understand the magnitude of NISA-related wetland impacts not only in terms of numbers and surface areas of wetlands affected, but also the nature of those impacts (i.e., wetland basins or margins). As a precursor to this, however, a wetland data base is required.

Wetlands in portions of Canada (particularly the Prairie Provinces) are currently being documented using satellite imagery (primarily by Ducks Unlimited Canada) and limited ground-truthing. Satellite technology allows for broad areas to be surveyed but the degree of resolution is insufficient to identify small wetlands. Other imagery such as False Colour Infra-Red photography provides good resolution but is more expensive. Ground-based surveys also provide good detail but they are labour intensive and impractical for surveying large areas.

The Canadian Wildlife Service in conjunction with the U.S. Fish and Wildlife Service have, since 1955, annually monitored wetland abundance along a standardized series of transects within selected portions of Canada as part of waterfowl inventory studies. This provides an excellent data base for describing long-term trends in wetland occurrence. It does not, however, provide an overall inventory of Canada's wetlands.

The Canadian Wildlife Service also monitors impacts on wetland basins and margins, again, by sub-sampling along pre-selected transects throughout portions of rural Canada (Turner et al. 1987). While this approach provides valuable information, it does not sample a very large area. Furthermore, by focusing on seasonally flooded, semi-permanent and permanent wetlands, other wetlands, notably ephemeral or temporary ones are not examined. These latter wetlands are important not only for wildlife but for a host of other wetland functions. Additionally, due to their small size and shallowness, they are also more susceptible to agricultural-related impacts.

Given the broad geographical area to be addressed, some form of remote sensing must be used. Satellite imagery holds promise but a greater level of resolution (5 m x 5 m pixels versus current 30 m x 30 m) than is currently available would be desirable. The United States has a National Wetland Inventory Program where False Colour Infra-Red aerial photography (scale of 1:48,000) is used to monitor "swampbuster" compliance. This scale of photography allows even the smallest of temporary wetlands to be identified. Additionally, this approach would be suitable for monitoring critical upland habitats. However, while it is comprehensive, it is also expensive. A role also exists for ground-truthing, particularly where uncertainty about impacts due to human influences versus climate exists.

It would appear that a combination of techniques could be used. Satellite imagery could be used to monitor overall trends in larger wetlands and upland landscapes on a regular, but infrequent basis. More detailed False Colour Infra-Red aerial photography could be obtained in representative agroecological areas more frequently to monitor impacts to wetlands and critical upland habitats. Convenient sized areas for this approach tend to be 3.2 km x 3.2 km blocks. With time, all of the agricultural zone of Canada should be inventoried in this manner. Selected blocks could be chosen for long-term monitoring purposes. If compliance evaluation becomes an issue, then these blocks could be randomly selected on an annual basis for inspection.

7.2.5.5 Surface Water Quality

In this evaluation of NISA, environmental impacts to surface water quality were limited to potential changes in non-point source pollution (NPSP) risk as inferred from an increase in the rate of eroded soil thickness. There was no consideration of the surface water body that drained the agricultural area, nor any consideration of where that water body ultimately flows. The impact of non-point source loadings on surface water quality is both a function of the amount of nitrogen, phosphorus and sediment being generated and the capability of

the water body to assimilate the material. For example, large fast flowing rivers may not be as impacted by non-point source runoff as shallow lakes.

A component of assimilative capability is also existing water quality conditions. Some water bodies already have more nutrients or sediments than they can assimilate and ecological utilization of that water body may already be impaired.

Surface water quality monitoring is conducted on a national scale by Environment Canada through both the Water Quality Branch and through the Water Resources Branch. The Water Resources Branch only collects information with respect to sediment transport and accumulation, whereas Water Quality Branch monitors all of the various chemical parameters from nitrogen and phosphorus through pesticides and priority pollutants. The Federal agencies tend to have monitoring locations at provincial and international boundaries and in the National Parks.

Provincial agencies and in some cases, local authorities also monitor water quality usually at more locations but generally, with less rigor as the monitoring is usually issue specific versus baseline monitoring.

On a watershed basis, phosphorus, nitrogen and sediments can be monitored to determine effects due to land use changes. In fact there likely exists a wealth of water quality data at numerous locations which can, and indeed may have already been analyzed to detect trends with time. This type of monitoring and analysis does not monitor change at the farm level but the cumulative effects of all changes in the basin. In watersheds which are entirely agricultural, interpretation of the results are more straight forward. However, in mixed function watersheds, sources of nitrogen, phosphorus and sediments other than agricultural must be subtracted. A significant non-agricultural source of these parameters are industrial and municipal point source discharges. These are however monitored intensely and can therefore be accounted for.

Water quality monitoring at the outlet of watersheds is a valid monitoring approach for assessing change. While may of the water quality monitoring programs already exist, they should be reviewed with respect to providing the specific requirements of evaluating agricultural non point source runoff effects.

Trace organic chemicals like pesticides and herbicides are difficult to monitor in the aquatic environment because they usually occur in concentrations below analytical detection limits. Being below an analytical detection limit does not necessarily mean that they do not have any ecological effects. An effective method of monitoring for trace organic chemicals is through benthic invertebrates. Benthic invertebrates inhabit the bottom sediments in all natural waterbodies. They are relatively non-mobile and are affected by long-term exposure of trace contaminant levels through bioaccumulation and lethality. Benthic invertebrates have a broad range of susceptibilities to contaminants and have been used as biomonitors for so long that there is a wealth of information on what species are sensitive to which types

of contaminants. Their long history as biomonitors also provide information to assess past as well as future trends. Benthic invertebrate monitoring is presently a common biomonitoring tool below point source discharges.

7.2.6 Information Deficiencies/Future Study Needs

7.2.6.1 Introduction

This study represents the first environmental assessment of Canada's farm programs. While it is a comprehensive assessment, many aspects of the present environmental assessment were limited by information deficiencies. These include:

- Limitations in our ability to acquire primary data on farmer land use behaviour because of privacy considerations.

- Inaccuracies inherent to the soil layer information obtained from the National Soil Data Base. The SLF was developed independently by provincial soil survey units of CLBRR. Inconsistencies between these units has yet to be resolved. These inconsistencies led to some inaccuracies.

- Land Use Diversity Indices (LUDI) using dis-aggregated grains and oilseed data for each NISA reporting area need to be calculated if we are to obtain better indices of changes in cropping diversity attributable to NISA.

- Inaccuracies inherent to econometric and biophysical models. This is especially true of the EPIC model when applied at the reporting area level rather than at the field level for which it was initially designed.

- Limited period of effective NISA program (one year). Econometric and biophysical information aggregated at reporting area level is unlikely to reflect minor changes in land use and environmental impacts after such a short period. Moreover, many producers might wait until they fully understand the new programs before they change their land use or input use practices.

7.2.6.2 Further Characterization of Farmer Attitudes and Characteristics

Despite a rather comprehensive survey of Canadian farmers during this study, additional analysis of farm characteristics and attitudes would be useful. Miranowski and Anderson (1993) concluded that farm characteristics need to be better understood in order to design and implement effective conservation and environmental policies. Such information would improve program delivery efficiency by targeting problem areas and allocating incentives to farms to ensure maximum cost-effectiveness for expenditures of public monies. For example, Miranowski and Anderson (op. cit.) found that farmers operating large farms represented a substantial proportion of the total farmland in the U.S. and also displayed a

high rate of participation in farm programs. With finite public monies available for farm support programs, it could make sense to focus monies on these operations as they would yield higher conservation benefits. However, in the absence of more detailed information on characteristics of these farms, policies relating to environmental sustainability will be much less focused.

7.2.6.3 Land Use and Soil Productivity and NPSP Risk

The assessment of the impact of land use changes on the rate of soil erosion, and indirectly soil productivity and NPSP risk, is deficient to the extent in that it is not sufficiently integrated at the regional (reporting area) level. This greater integration involves the integration of soil and hydro(geo)logic processes as well as the integration of GIS, Image Analysis Systems and biophysical modelling. For instance, the integration on a watershed basis of soil based (SWRRB), nonpoint source pollution based (AGNPS, ANSWERS) and wildlife habitat based (HEP) merits consideration for future study. To a large extent, this integration approach to the assessment of land use's environmental impact on soil productivity and NPSP is an adaptation of the USEPA's work, especially in Wisconsin (Buchan et al. 1991; Buchan et al. 1992; USEPA 1993).

The main information deficiencies pertain to the change in the areal extent of prevalent land use scenarios, and to the accuracy of the soils and topographic data necessary to perform legitimate simulations of the environmental impacts of this change. The data extensively collected as part of the cross-compliance evaluation effort could very effectively supplement, if not supplant surveys and other means of opinion polling. Remote sensing necessary for this data collection could also serve to improve the topographic parameters used by EPIC. The accuracy of the soils information used by EPIC is largely the responsibility of the developers of the Soil Layer File, that is CLBRR.

There is an inherent limitation to the estimation of environmental impacts using the product of the change of the areal extent in prevalent land use scenarios and the EPIC generated long-term soil productivity and NPSP risk indicators. The EPIC generated long-term average for a given land use scenario is not necessarily proportional to the long-term environmental impact of this scenario. A gradual yield decrease over time and an accelerated yield decrease preceded by little or no change could lead to similar long-term average yield values. However, an accelerated yield decrease is a sure indication that irreversible soil degradation has occurred and that the sustainability of the agroecosystem is threatened, whereas a more gradual decrease is an indication that the agroecosystem is, to some extent, buffering change and that soil degradation is still reversible.

The exhaustive analysis of the EPIC-generated responses of soil productivity and NPSP risk over time could allow us to determine a more suitable index of agricultural sustainability than the long-term average. Such an analysis was attempted by EMA. It was based on an attempt to quantify the gradual and catastrophic soil productivity and NPSP risk trends. The resulting values could then replace the long-term averages of eroded soil thickness presently

multiplied by the surveyed changes in areal extent of prevalent land use scenarios. The resulting estimate would be more indicative of the impact of land use changes attributable to NISA on environmental sustainability than the present estimates based on long-term average erosion rates.

EMA's attempt at such an exhaustive analysis of the impacts on environmental sustainability of the land use changes attributable to NISA, and GRIP, was limited by:

1. The inherent inaccuracies of EPIC when applied on an areal extent beyond the field or quarter section. Though we have qualified the appearance of the soil productivity and NPSP responses and the long-term averages we have obtained, these EPIC outputs may not justify an exhaustive analysis. We would have to at first verify that the occurrence of thresholds and gradual trends is in fact an inherent quality of the agroecosystem rather than an artifact of EPIC when applied at the regional level.

2. The inherent inaccuracies of the Soil Layer File (SLF) developed by the Centre for Land and Biological Resource Research (CLBRR). The accurate description of the soil profile's horizons is the single most important EPIC requirement. The SLF's chemical and physical description of soil horizons is presently unstandardized and inaccurate in many respects. Many of the EPIC parameters had to be generated by EPIC itself which increases the incidence of idiosyncrasies and artifacts.

3. The tedious aspect of trend and threshold analysis. Unexpectedly, the analysis of the simulated long-term responses of soil productivity and agricultural NPSP risk required much more than the determination of linear regression coefficients and the identification of discrete thresholds. Most of the responses deemed linear were very gradual and thus had very small regression coefficients with large errors associated to them. Discrete thresholds rarely occurred or did so haphazardly or were difficult to rationalize agronomically.

7.2.6.4 Wildlife Habitat

The primary information deficiencies relate to the absence of a comprehensive data base on wetland distribution and abundance. With these data in hand, examples of some key questions that should be posed and researched include:

- What habitat information is required to model the effects of broad landscape changes on wildlife populations? As described earlier, it is clear that detailed inventories of wetland numbers, types and distribution represent some of the obvious data requirements. Similarly, from a terrestrial habitat perspective, the location and amount of riparian, grassland and woodland habitats needs to be documented. However, there may be much more detailed information required,

such as vegetation species composition and vegetation structure (e.g. density and height) to model habitat capability and sensitivity to change.

- Documentation of the numbers and surface areas of wetlands, and surface areas of upland habitats affected by NISA.
- What farming-related changes in habitat features will trigger habitat degradation?
- What are thresholds for various habitats beyond which species sustainability is jeopardized?
- What are the cumulative impacts of habitat loss on species that are dependent upon these various habitats?
- What differences in bio-diversity exist under various land use practices?

7.2.6.5 Other Issues

More information on air quality, surface water quality and fisheries would be desirable for a more comprehensive environmental assessment of NISA-related impacts. These data could be collected through a combination of farmer surveys as well as secondary information arising form other research endeavours. In particular, these could include:

Air

- documentation of the atmospheric effects of different land uses. For example, do grassland areas act as a carbon sink relative to cultivate areas?
- documentation of what increments in farm machinery utilization could lead to measurable increases in air emissions?
- documentation of the magnitude of different land use practice contributions to air pollution in the form of blowing dust. For example, how much more wind-borne dust emanate from summerfallow fields versus zerotill fields?

Water Quality

- documentation of the effects of pesticide and fertilizer inputs on nonpoint source pollution in densely inhabited areas such as southern Ontario versus less densely inhabited areas such as the Prairie Provinces.
- Watershed scale modelling of the aquatic concentrations resulting from predicted non-point sources runoff.

Fisheries

- documentation of the effects of riparian habitat removal on fisheries resources.
- documentation of the effects of nonpoint source pollution on fisheries resources.
- future environmental assessments of GRIP/NISA should include estimates of LER, GMA and the agronomic and phytopathological benefits of increased intro-specific genetic diversity. These agronomic parameters are more likely to yield conclusive data than ecological measurements of biological and species diversity ill-adopted to agroecosystems.

With these data in hand, examples of some key questions that should be posed and researched include;

- What habitat information is required to model the effects of broad landscape changes on wildlife populations. As described earlier, it is clear that detailed inventories of wetland numbers, types and distribution represent some of the obvious data requirements. Similarly, form a terrestrial habitat perspective, the location and amount of riparian, grassland and woodland habitats needs to be documented. However, there may be much more detailed information required, such as vegetation species composition and vegetation structure (e.g., density and height), to model habitat capability and sensitivity to change.
- What are the cumulative impacts of habitat loss on species that are dependent upon these various habitats?
- What differences in bio-diversity exist under various land use practices?

7.3 SUMMARY

This chapter has focused on the extent to which NISA has influenced agro-ecosystems specifically, and the environment in general. It must be emphasized that the conclusions drawn from this assessment are based on a short evaluation period. Moreover, because the program was new, it is likely that many producers did not want to change their farming practices until they fully understood the program and/or until they were convinced the program would continue in the years ahead. Because FIPA requires that programs undergo environmental reviews every five years after the initial assessment, there will be opportunities in the future for better assessments of the longer-term effects of NISA.

It is important to re-state that the scope of this environmental assessment was confined to the period immediately preceding the introduction of NISA and the first two years of NISA's operation. It was intended to measure the incremental changes in environmental performance because of NISA. It was not an evaluation of the implications of farm support

systems versus no farm support systems. This was the case because Canada has a long-standing history of farm support systems such as crop insurance, WGSA and various ad hoc programs dating back over 30 years.

A summary of the impacts of NISA at the Provincial and National level for the primary measures of environmental performance is presented in Table 7.3.

HAS NISA AFFECTED CROPPING AND LAND USE DIVERSITY?

Crop and land use diversity is considered to be important because a more diverse crop mixture should help insulate farmers from the vagaries associated with adverse growing and market conditions. Additionally, greater land use diversity is considered valuable because of the variety of environments available to Canada's flora and fauna.

The survey results indicated that the vast majority of NISA participants did not view the program as one that would stabilize their income. Hence, it was not surprising that most farmers indicated they did not change their risk management strategies such as pesticide usage, fertilizer practices, crop selection or land management. Indeed, the vast majority of farmers (94%) were not influenced by NISA to decrease their diversity of crops.

A companion analysis of land use diversity based on Canada Census data and the farmer surveys revealed that overall land use diversity did not decrease during the period of assessment. However, because this analysis could not control for NISA (i.e., could not directly verify the program's influence on land use diversity), we placed more weight on the findings of our statistical modelling. **Thus, we concluded that the overall impact of NISA on cropping and land use diversity was a negative, negligible, short-term impact.** We considered it a short-term impact because a changing market will influence cropping diversity.

HAS THE LACK OF WHOLE FARM COVERAGE UNDER NISA CAUSED ENVIRONMENTAL DEGRADATION?

NISA is a form of self-insurance through management of a financial reserve. Funds withdrawn from the reserve are likely to mean fewer funds available upon retirement. Therefore, farmers have the incentive to manage payouts in the context of a reduced retirement annuity. These incentives should result in comparable decisions with respect to input use and crop and livestock production as if there were no stabilization program. Moreover, the environmental performance of a NISA whole farm coverage program would be comparable to a market driven allocation of resources.

HAS NISA AFFECTED SOIL EROSION AND NON-POINT SOURCE POLLUTION?

Accelerated soil erosion arises when soils are exposed to the influences of wind or water. This erosion removes topsoil and can decrease soil productivity and increase non-point

TABLE 7.3

SUMMARY OF THE IMPACTS OF THE 1992 NISA PROGRAM ON FARMING PRACTICES AND LAND USE DECISIONS

ISSUE	B.C.	ALTA.	SASK.	MAN.	ONT.	P.E.I.	N.S.	N.F.	CANADA
Cropping/Land Use Diversity	-NS	-NS	-NS	-NS	-NS	-NS	-NS	-NS	-NS
Soil Erosion	+MiS	+MiS	+MiS	+MiS	+MiS	0	0	0	+MiS
Water Quality	+NS	+NS	+NS	+NS	+NS	0	0	0	+NS
Habitat (Wetlands)	-MiL	-MiL	-MiL	-MiL	-MiL	-MiL	-MiL	0	-MiL
Habitat (Upland)	0	-NL	-NL	-NL	-NL	0	0	0	-NL
Air Quality	+NS	+NS	+NS	+NS	+NS	0	0	0	+NS
Cumulative	-MiL	-MiL	-MiL	-MiL	-MiL	-MiL	-MiL	0	-MiL

*Impact Direction, Magnitude and Duration, where:

Direction: + (Positive), - (Negative), 0 (Neutral)
Magnitude: N (Negligible), Mi (Minor), Mo (Moderate), Ma (Major)
Duration: S (Short-term - < 10 years), L (Long-term - > 10 years and/or several generations)

source pollution through the introduction of nutrients, fertilizers and pesticides into receiving waterbodies.

Based on evidence of more conservation tillage, less summerfallow and more forage crops, there was compelling evidence that NISA could be considered in its first years of operation to have had **a positive, minor, short-term impact in terms of reduced potential for soil erosion and non-point source pollution.** The degree to which this will hold true for the longer-term is less certain because land use practices might change with a changing market. Nonetheless, EPIC simulations suggested that existing farming practices will result in sustained soil productivity for the foreseeable future.

HAS NISA AFFECTED WATER QUALITY?

Water quality can be affected by introduction of nutrients and other farm products into receiving waterbodies. The effect of NISA on water quality was measured by evaluating inputs of fertilizers and pesticides, land use practices, and EPIC simulations to measure the likelihood of non-point source pollution.

NISA had no appreciable impact on the use of chemicals and thus impacts on water quality from this perspective were unlikely. As described in the soil erosion discussion, farming practices under the NISA regime should actually lead to reduced erosion and improved water quality; but these improvements would be difficult to detect on a broad geographic basis. EPIC simulations confirmed no existing or projected increases in non-point source pollution. Thus, it was concluded that **water quality under NISA had a positive, negligible, short-term impact.** Again, we considered the impact short-term because a changing market could result in changing land use and input use practices.

HAS NISA AFFECTED WILDLIFE HABITAT INCLUDING WETLANDS?

Farming activities have the potential to decrease wildlife habitats through wetland drainage or cultivation of grassland habitats or conversely, to increase them through conservation-tillage or planting of forage crops. The impacts of NISA on wildlife habitats were assessed in terms of wetland and upland habitats, based primarily on surveys of farmers and indirectly through measures in land use practices.

As far as wetland habitats are concerned, a relatively large proportion of survey respondents (16%) indicated that they had drained wetlands between 1990 and 1992, although the proportion of farmers that attributed this drainage to NISA was small (less than 6% of those that drained wetlands). This provides strong evidence that wetland drainage continued through 1991 and 1992 on a large scale and that NISA apparently exacerbated the problem. While the number or surface area of wetland basins adversely affected by NISA was likely to have been small, the cumulative effect of continual drainage under the program is likely to be larger with time. Wetland margins also contribute to the overall functional capability of wetlands and there was evidence that these were also adversely affected by NISA. Again,

however, the proportion of farmers attributing this to NISA was small (less than 2%). Notwithstanding, the cumulative effect of continual wetland margin degradation under the program is likely to be larger with time.

Wetland creation programs do exist in Canada and while they add to Canada's inventory of wetlands, this is occurring independent of NISA. Thus, given Canada's dwindling wetland resource, Canada's position on "no net loss of wetland function", the vulnerability of continental waterfowl populations which rely upon wetlands and their margins, and the stated objectives of the North American Waterfowl Management Plan to increase wetland habitats and waterfowl populations, **the degradation of Canada's wetland resource because of NISA was concluded to be a negative minor impact in the short-term, but could lead to a negative moderate/major impact in the long-term because of incremental wetland losses.** The rationale for long-term impacts relates to the fact that once wetland basins are destroyed, they have lost their long-term functional values. Given this adverse impact, mitigation measures are recommended. For example, Canada should give consideration to approaches to wetland conservation such as "swampbuster" which has been implemented for U.S. farm programs. These measures coupled with incentives could lead to a net gain in Canada's wetland resources. Cross-compliance to protect wetland resources could be delivered by withholding, restricting or enhancing government contributions to NISA accounts conditional upon meeting defined environmental protection criteria.

For upland habitats, NISA evidently did not adversely affect grassland or woodland areas in terms of converting them to cultivated lands. Indeed, there was an increase in forage crop acreage which would be beneficial to wildlife. Similarly, the reduction in summerfallow acreage and the adoption of more conservation tillage practices would also be advantageous to wildlife. There was, however, a NISA-related influence on farmers to reduce the width of their field margins and also riparian habitat zones. Again, the proportion of farmers influenced in this regard was small and largely confined to the Prairie Provinces. Thus, on balance, despite some declines in upland habitat, there were compensatory increases through changing land use practices that would suggest that for Canada as a whole, **the impact of NISA on upland habitat was negative, negligible and long-term.** This conclusion is not intended to suggest that the identified degradation of upland habitats is acceptable. Rather, we would recommend that mitigation in the form of cross-compliance measures such as "sodbuster" be considered to slow or halt further loss of these habitats. By invoking such measures, coupled with incentives to encourage the identified gains associated with conservation tillage, reduced summerfallow and more forages, we could begin to see an accrual, rather than loss of wildlife habitat, similar to what is occurring in the U.S. (Young and Osborn 1990).

HAS NISA AFFECTED AIR QUALITY?

Air quality could be affected by dust arising from soils exposed to wind erosion or through greenhouse gases such as carbon dioxide being released from cultivated lands.

As described above, soil erosion has been reduced under NISA, which should result in improved air quality through a reduction in wind borne dust. The increase in conservation farming practices and increased forage acreage also could contribute to a reduction in carbon dioxide which would otherwise be emitted from summerfallow lands. It would, however, be difficult to detect these improvements in air quality and **thus, NISA was considered to have positive, negligible, short-term impacts on air quality.** As with water quality, a changing market could result in changing land use and input use practices; hence the designation as a short-term impact.

OVERALL ENVIRONMENTAL IMPLICATIONS OF NISA

When all the environmental performance measures were considered, it was determined that the impacts of NISA were both positive and negative, and in some instances neutral. In no instance, however, were those impacts determined to be more than minor in nature, on an impact evaluation scale ranging from negligible through minor, moderate and major.

Based on an evaluation of the first 2 years of NISA, NISA's cumulative impact was considered to have been negative and minor; a conclusion triggered by the degradation of wetlands. This degradation, albeit small in scale, was considered to be sufficiently important because of stated Canadian policies for wetland protection, to supersede the several positive impacts of NISA. Mitigation measures are recommended to address the concerns relating to wetland and upland habitat degradation.

A further evaluation of NISA's implications to wetlands and other environmental issues will be the focus of the next environmental assessment after 5 years of NISA.

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APPENDIX I

SCOPE OF WORK

SCOPE OF WORK

PHASE 1 - IDENTIFY GRIP AND NISA ENVIRONMENTAL ASSESSMENT ISSUES

1.1 The Contractor shall meet with the Agriculture Canada representative, before commencing the duties below, to review contract requirements, to discuss any initial needs or concerns of the Contractor, and to receive relevant documents from the Agriculture Canada representative.

1.2 The Contractor shall, for both GRIP and NISA,

(a) document the relevant details of the programs in each participating province, including any special features and administrative arrangements that may be important for the environmental assessment.

(b) identify, in consultation with the Agriculture Canada representative, and interview, three or four key resource personnel per province in British Columbia, Alberta, Saskatchewan, Manitoba and Ontario, one or two knowledgeable individuals in Quebec and one or two knowledgeable individuals in the Maritimes. These interviews are intended to obtain information about the programs and about their possible environmental impacts and assessment issues in each province.

(c) summarize information supplied by the Agriculture Canada contract representative, information obtained through literature review, and information obtained through structured interviews with provincial, federal and private resource professionals.

(d) identify, and provide a detailed written report on, the environmental assessment issues in each participating province. Examples of potential environmental assessment issues are contained in **Appendix D.**

1.3 The Contractor shall

(a) develop a conceptual, analytical framework to be used in assessing qualitatively and quantitatively the direct and indirect environmental effects of the Gross Revenue Insurance Plan and the Net Income Stabilization Account, together with the related socio-economic consequences of those environmental effects.

(b) ensure that the analytical framework is compatible with the general approach to environmental assessment described in **Appendix E,** and, to the extent reasonably possible, that it uses and builds upon the material ccntained in **Appendix F.**

(c) ensure that the framework shall allow the effects and consequences of the two programs to be separately identified and analyzed.

(d) organize and conduct a workshop to facilitate the development of the analytical framework.

(e) ensure, to the extent reasonably possible, that all key members of its study team participate in the workshop.

1.4 The Contractor shall prepare the survey questionnaires for each province and submit them, not later than twenty days following the close of the workshop, to the Agriculture Canada contract representative for review and approval before proceeding with the survey.

PHASE 2 - SURVEY

2.1 The Contractor shall

(a) assemble and tabulate relevant agricultural land use data for all participating provinces covering, at a minimum, the years 1987, 1988, 1989, 1990, 1991 and 1992, from Statistics Canada, GRIP (including crop insurance) and NISA Program sources, and/or any other appropriate source.

(b) ensure that the land use data cover all producers, all eligible crops, summerfallow acreage, and include all accessible and appropriate land use data needed to support an analysis of whether land use under GRIP and/or NISA differs in a statistically significant way from land use in the years immediately preceding introduction of the programs.

(c) assemble and tabulate relevant data and information on input use (manures, chemical fertilizers, pesticides, fuels, labour, etc.), rotations and other management practices, that are needed in order to establish cause-effect linkages between the programs and their environmental effects (direct and indirect).

2.2 To facilitate the data and information gathering activities in section 2.1 above, and to aid in establishing linkages between the programs and any changes in land and input use by program participants, the Contractor shall

(a) administer a mail out survey of farmers in all provinces participating in the GRIP and NISA programs, making use for this purpose of the questionnaires approved by the Agriculture Canada representative.

(b) ensure that farmers to be surveyed shall be assigned to one of four farmer groups for each province as follows: GRIP only; NISA only; both GRIP and NISA; neither GRIP nor NISA.

(c) ensure that all provinces participating in GRIP and/or NISA shall be sampled.

(d) ensure that sample populations in each province shall be stratified by major soil region as defined in Agriculture Canada's publication "Soils of Canada", substantially as follows:

British Columbia:	C2 Gray Luvisol (Gray Wooded)
Alberta:	A1 Brown Chernozemic A2 Dark Brown Chernozemic A3 Black Chernozemic Solonetzic Soils (B1, B2 and B4 pooled) C2 Gray Luvisol (Gray Wooded)
Saskatchewan:	A1 Brown Chernozemic A2 Dark Brown Chernozemic A3 Black Chernozemic C2 Gray Luvisol (Gray Wooded)
Manitoba:	A3 Black Chernozemic A4 Dark Gray Chernozemic C2 Gray Luvisol (Gray Wooded)
Ontario:	C1 Gray Brown Luvisol E1 Melanic Brunisol
Quebec:	E1 Melanic Brunisol
Maritimes combined:	C2 Gray Luvisol (Gray Wooded)

(e) ensure that, within each province, random samples from the four farmer groups shall be drawn, without replacement, until 150 individuals from each farmer group are assigned to each soil zone stratum, and that, therefore, within each province, 600 farmers shall be sampled per soil zone stratum, resulting in the following number of farmers being sampled from each province:

British Columbia:	600
Alberta:	3000
Saskatchewan:	2400
Manitoba:	1800
Ontario:	1200
Quebec:	600
Maritimes combined:	600

(f) utilize four separate personalized mailings over a seven week period to administer the survey.

2.3 The Contractor shall

(a) use appropriate techniques to process the data and information collected and to analyze the factors influencing land and input use.

(b) assess whether and to what degree GRIP and/or NISA have contributed to changes in land and input use in each province.

(c) assess the degree to which GRIP has contributed to the cultivation of marginal or environmentally sensitive lands, including wetlands and Canada Land Inventory Classes 4, 5 and 6 lands.

(d) assess the degree to which GRIP has affected native and improved pasture lands and tame forage acreage, including any impacts on the Permanent Cover Program.

(e) ensure that the separate effects of GRIP and NISA shall be analyzed, as well as effects resulting from interactions between the two programs.

PHASE 3 - ENVIRONMENTAL ASSESSMENT

3.1 The Contractor shall

(a) apply the analytical framework developed pursuant to paragraph 1.3 (above) to an analysis of the direct and indirect environmental effects of GRIP and NISA and the significance of those effects, making use of the assembled land use data, land use analysis, input data and management information, together with any other published or unpublished analysis that may be available and relevant for this purpose.

(b) conduct discipline-specific environmental assessments of impacts of GRIP and NISA on agricultural soils, indigenous plants, water quality/fisheries, air quality, and wildlife.

(c) ensure that the discipline-specific assessments shall make use of all of the data and information gathered through literature reviews, interviews with key resource personnel in each province, the survey data, and any other available and relevant data and information.

(d) ensure that the discipline-specific assessments shall combine biophysical data with quantitative survey data, and with the aid of tools such as predictive models, shall determine the quantitative and/or qualitative impacts of the GRIP and NISA programs.

(e) synthesize all of the discipline-specific assessments into the comprehensive environmental assessment, and shall specifically assess the significance of all identified effects and consequences, including cumulative environmental effects, and related socio-economic consequences of the environmental effects.

3.2 The Contractor shall

(a) employ a Geographic Information System (GIS) to display and analyze actual and probable impacts of the GRIP and NISA programs. The GIS shall be used to integrate the soils capabilities and other baseline environmental information with the survey responses on a province by province basis.

(b) produce maps to illustrate changes in land use and environmental impacts since the introduction of GRIP and NISA.

3.3 The Contractor shall

(a) complete a socio-economic assessment of GRIP and NISA, with particular reference to the influence of these programs on farmers' decisions with respect to crop selection, input use and management in each participating province.

(b) analyze how farmers in Manitoba perceive the GRIP program in terms of fertilizer and pesticide usage. This analysis shall be done for Manitoba in terms of yield response relationships estimated from data compiled by the Manitoba Crop Insurance Corporation. The effect that GRIP had on farm cropping decisions shall be analyzed from secondary data aggregated to the provincial level in the context of the historical marketing and production environment.

PHASE 4 - REVIEW OF POTENTIAL AMENDMENTS AND REPORT WRITING

4.1 Based on the environmental assessment findings, the Contractor shall

(a) identify and assess mitigation measures, including the feasibility of amendments to GRIP and/or NISA that would improve the environmental performance of the programs.

(b) through a literature review and through structured interviews with appropriate individuals in the United States and Canada, assess the potential and feasibility of implementing environmental cross-compliance measures under GRIP and/or NISA, drawing upon the discussion of this concept contained in **Appendix G**.

(c) make recommendations regarding the need for environmental regulations under the Farm Income Protection Act or any other relevant agricultural or environmental legislation of Canada or a province.

(d) ensure that, in assessing the feasibility of implementing environmental cross-compliance measures, particular attention is given to the wording contained in Section 5(2)(a) of FIPA, Section 19.3 of the Federal-Provincial GRIP Agreement, and Section 6.7 of the NISA Agreement.

(e) make recommendations on the circumstances and conditions under which insurance should be withheld, restricted or enhanced for the purpose of protecting the environment and encouraging sound management practices that promote environmental sustainability (see FIPA Section 5(2)(a)).

(f) complete an assessment of any residual impacts that may remain even after the implementation of recommended mitigation measures, and shall assess the significance of those residual impacts.

(g) ensure that the final reports shall include recommendations on a national monitoring program, including appropriate environmental indicators and threshold values.

(h) ensure that all recommendations made for mitigation measures, environmental cross-compliance and national monitoring of natural resources are appropriate in light of the results of the environmental assessment.

4.2 The Contractor shall write the environmental assessment reports (separate reports for GRIP and NISA) covering all the above elements (sections 1.2 to 4.1 above), and shall include table of contents, executive summary, references, data tables, maps and other required items in accordance with the **"Deliverables"** (below). In order to avoid duplication between the separate reports for GRIP and NISA, the NISA report may reference the larger GRIP report for details of methodology, background and any other common elements of the overall assessment, at the discretion of the Contractor.

APPENDIX II

INDIVIDUALS INTERVIEWED FOR GRIP/NISA ENVIRONMENTAL SCOPING ASSESSMENTS

Structured face-to-face interviews were employed to identify environmental issues associated with GRIP within each province and reveal any issues that were not identified in the reports supplied by Agriculture Canada and the literature review. Interviews with key agricultural, environmental, and natural resource personnel (names attached) were conducted within each province during June-July 1992 by EMA scientists D. A. Young and Brian T. Gray. Prior to initiating each interview, all interviewees were assured complete confidentiality in their responses. A combination of open-ended and closed questions were used to assure interviewees had opportunity to provide unbiased and exhaustive responses. The questionnaire format assured that interviewees were first provided an opportunity to identify what they thought were the most important environmental issues associated with GRIP. Then, to assure that all environmental concerns identified in the initial environmental assessment conducted by Agriculture Canada were discussed with each of the interviewees, they were asked to evaluate specific issues.

As requested by the client, environmental issues were identified as GRIP-induced changes relative to the baseline in existence immediately prior to GRIP (i.e., Crop Insurance plus ASA/WGSA).

APPENDIX II. INDIVIDUALS INTERVIEWED FOR GRIP/NISA ENVIRONMENTAL SCOPING ASSESSMENTS

ALBERTA

Dan Stryker - Alberta Conservation Tillage Society
John Hermans - Alberta Agriculture
Les Lyster - Alberta Agriculture
Len Fullen - Alberta Agriculture
David Neilson - Alberta Agriculture
Morley Barrett - North American Waterfowl Management Plan
Ernie Ewaschuk - North American Waterfowl Management Plan
Scot McClure - Alberta Environment
Bill MacDonald - Alberta Environment

ATLANTIC CANADA

Brian Mahoney - Nova Scotia Crop and Livestock Insurance Commission
George McIntosh - Nova Scotia Crop and Livestock Insurance Commission
Paul Smith - New Brunswick Crop Insurance Commission
Abe Gahn - New Brunswick Crop Insurance Commission
Bob Macgregor - Prince Edward Island Agricultural Development Corp.
Andre Lavoie - Prince Edward Island Department of Environment
Rosemary Curley - Prince Edward Island Department of Environment
Thomas Duffy - Prince Edward Island Department of Environment
Keith McAloney - North American Waterfowl Management Plan
Bruce Pollard - Institute for Wetland and Waterfowl Research

BRITISH COLUMBIA

Rob Kline - B.C. Ministry of Agriculture and Finance
Jack Dobb - B.C. Ministry of Agriculture and Finance
Bill Greenhalgh - B.C. Ministry of Agriculture and Finance
Lee Bowd - B.C. Ministry of Agriculture and Finance
Mike Cowley - B.C. Ministry of Agriculture and Finance
Herb Luttmerding - B.C. Environment
Sylvia von Schuckmann - B.C. Environment
Brian Churchill - B.C. Environment
Gary Scott - GRIP National Committee Member

MANITOBA

Richard Downey - Agriculture Canada
Don Russell - Agriculture Canada
Bruce Kirk - Agriculture Canada
Denis Tully - Agriculture Canada
David Petkau - Agriculture Canada
Terry Neraasen - Ducks Unlimited Canada
Dale Partridge - Manitoba Agriculture
John Dean - Manitoba Agriculture
Herb Sulkers - Manitoba Agriculture

ONTARIO

Chris Horbasz - Ontario Ministry of Agriculture and Food
Roger Donais - Ontario Ministry of Agriculture and Food
Shelley Allan - Ontario Ministry of Agriculture and Food
Martin Bohl - Ontario Ministry of Agriculture and Food
Howard Lang - Ontario Ministry of Agriculture and Food
Len Senyshyn - Ontario Ministry of Agriculture and Food
Harold Rudy - Ontario Soil and Crop Improvement Association
Terry Daynard - Ontario Corn Producers' Assocation
Elbert Van Donkergoed - Christian Farmers Federation
Ken Cox - North American Wetlands Conservation Council (Canada)
Jim Patterson - North American Waterfowl Management Plan
George Pearson - Agriculture Canada
Brian Paddock - Agriculture Canada
Julian Dumanski - Agriculture Canada
Marjorie Cann - Agriculture Canada

QUEBEC

Stuart Hill - MacDonald College

SASKATCHEWAN

Neil Kettilson - Saskatchewan Wheat Pool
Bob Rugg - Saskatchewan Institute of Agrologists
James Lokken - Saskatchewan Soil Conservation Association
Garth Patterson - Saskatchewan Soil Conservation Association
Ron Zukowski - Saskatchewan Environment and Public Safety
Tom Galimberti - Saskatchewan Environment and Public Safety
Ron Quinn - Saskatchewan Environment and Public Safety
Henry Epp - Saskatchewan Environment and Public Safety
Martin Wrubleski - Saskatchewan Agriculture and Food
Wayne Gosselin - Saskatchewan Agriculture and Food

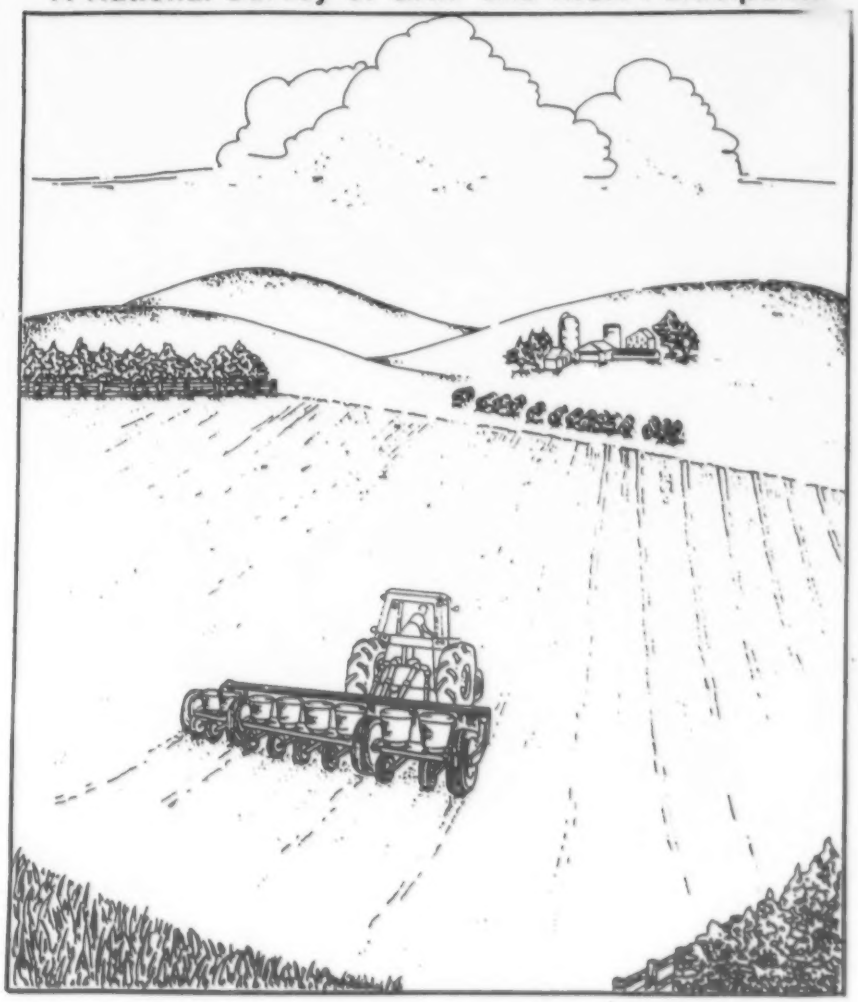
Mike McAvoy - Saskatchewan Agriculture and Food
Donn Farrer - Saskatchewan Agriculture and Food
Hal Cushin - Saskatchewan Agriculture and Food
Ralph Howes - Saskatchewan Agriculture and Food
Graham Dorn - Saskatchewan Wetlands Conservation Corporation
Greg Reimer - Saskatchewan Wetlands Conservation Corporation
Merle Boyle - PFRA
Pierre-Phillipe Claude - PFRA
Rob Kohlert - PFRA
George Brown - PFRA
Elliott Allison - PFRA
Ken Thompson - PFRA

APPENDIX III

MAIL SURVEYS USED IN ASSESSMENT

GRIP/NISA VERSION OF QUESTIONNAIRE

ENVIRONMENTAL ASSESSMENT OF GRIP AND NISA
A National Survey of GRIP and NISA Participants



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EMA

INSTRUCTIONS

NOTE: The National Tripartite Gross Revenue Insurance Plan (GRIP) for grains and oilseeds was introduced in 1991. The program is comprised of two components revenue insurance (also known as revenue protection and price insurance) and crop insurance (also known as all risk crop insurance and yield protection). This questionnaire is structured to ask about these two components of GRIP separately. If you are enroled in the revenue insurance program only, please ignore the questions on crop insurance.

Please answer all questions as best you can and do not skip over any questions unless instructed to do so. Do not write your name on the questionnaire. All your answers are STRICTLY CONFIDENTIAL and will never be used in conjunction with your name. Return the questionnaire using the addressed, postage-paid return envelop provided. Thank you very much for your assistance.

If you have any questions please call 403-299-5640.

****

Ce questionnaire est aussi disponible en français. Si vous préférez recevoir la version française du questionnaire, vous n'avez qu'à cocher ici _____, et à nous le retourner dans l'enveloppe-réponse affranchie ci-jointe.

****

Provision of the information on this document is voluntary and you may, without prejudice, decline to respond. Some information may be accessible or protected as required under the provisions of the Access to Information Act. Information that could cause you or your organization injury if released is protected from disclosure as defined in section 20 of the Access to Information Act. The Collection Registration Number is AGR/GOB-835-05381.

1. Please show how the land on your farming operation was used during the 1990 and 1992 farming seasons (NOTE: Do not provide information on your 1991 acreages and do not include land that was leased out to others).

	1990	1992
Area seeded to grains, oilseeds, or pulses (e.g., wheat, barley, corn, canola, peas, lentils, beans, sunflowers, mustards, etc.)	_____acres	_____acres
Area seeded to vegetables, berries or nursery crops (e.g., potatoes, sugar beets, shrubs, flowers, strawberries, etc.)	_____acres	_____acres
Orchard lands	_____acres	_____acres
Summerfallow:		
· Cultivated summerfallow	_____acres	_____acres
· Chemfallow	_____acres	_____acres
Perennial crops (e.g., alfalfa)	_____acres	_____acres
Improved (Seeded) Pasture	_____acres	_____acres
Unimproved Pasture:		
· Grazed Woodlands/Shrublands (areas dominated by trees or shrubs)	_____acres	_____acres
· Grazed Grasslands (areas dominated by grasses)	_____acres	_____acres
Ungrazed Grasslands	_____acres	_____acres
Ungrazed Woodlands/Shrublands (include windbreaks)	_____acres	_____acres
All other land (include barnyards, feedlots, marshes, sloughs, etc.)	_____acres	_____acres
TOTAL LAND AREA	_____acres	_____acres

2. Do you live on or within 30 kilometres (18 miles) of your farmland? ____ Yes ___ No

IF NO, in what province and county [or rural municipality (R.M.)] is your nearest land?

Province:_____ County:_____ or R.M._____

3. For the cereal grains and oilseeds grown on your farm in 1992, was crop insurance taken out on (CHOOSE ONLY ONE):

____ None of these crops ____ Some of these crops ____ All of these crops

4. For your farm in 1992, the total premium paid by you for crop insurance and revenue insurance on grains and oilseeds was split approximately: (CHOOSE THE MOST ACCURATE RESPONSE)

___ 75% for crop insurance and 25% for revenue insurance

___ 50% for crop insurance and 50% for revenue insurance

___ 25% for crop insurance and 75% for revenue insurance

___ 0% for crop insurance and 100% for revenue insurance

___ Don't know

5. Please indicate the area of land that you prepared for the 1990 and 1992 seasons using the following tillage methods:

	1990	1992
Tillage which incorporated most of the crop residue into the soil	____ acres	____ acres
Tillage which retained most of the crop residue on the surface - such as minimum tillage	____ acres	____ acres
No tillage prior to seeding (for example, direct seeding into stubble)	____ acres	____ acres

6. If your tillage methods changed between 1990 and 1992, what influence do you feel revenue insurance had on your changes in tillage methods? (Please circle the appropriate number, where "0" means it had no influence on your changes in tillage methods, 10 means it was the only influence on your changes in tillage methods, and 1 through 9 are increasing levels of influence on your changes in tillage methods)

NO INFLUENCE THE ONLY INFLUENCE

0 1 2 3 4 5 6 7 8 9 10

7. What influence do you feel crop insurance had on your changes in tillage methods between 1990 and 1992?

NO INFLUENCE — THE ONLY INFLUENCE

0 1 2 3 4 5 6 7 8 9 10

8. What influence do you feel NISA had on your changes in tillage methods between 1990 and 1992?

NO INFLUENCE — THE ONLY INFLUENCE

0 1 2 3 4 5 6 7 8 9 10

IF YOU DO NOT USE SUMMERFALLOW, PLEASE SKIP TO QUESTION 13.

9. If you use summerfallow in your rotation, about how many times did you cultivate your fallow fields in 1990 and 1992?

Number of times in 1990 ____ Number of times in 1992 ___

- If the number of cultivations changed, explain why: _____

_____

_____

10. If your acreage of summerfallow changed between 1990 and 1992, what influence do you feel revenue insurance had on this change? (Please circle the appropriate number, where "0" means it had no influence on your change of summerfallow, 10 means it was the only influence on your change in summerfallow, and 1 through 9 are increasing levels of influence)

NO INFLUENCE — THE ONLY INFLUENCE

0 1 2 3 4 5 6 7 8 9 10

11. If your acreage of summerfallow changed between 1990 and 1992, what influence do you feel crop insurance had on this change?

NO INFLUENCE — THE ONLY INFLUENCE

0 1 2 3 4 5 6 7 8 9 10

12. If your acreage of summerfallow changed between 1990 and 1992, what influence do you feel NISA had on this change?

NO INFLUENCE										THE ONLY INFLUENCE
0	1	2	3	4	5	6	7	8	9	10

13. Please place an "X" by each of the following management practices that you currently use on your land.

____ Establishing permanent cover on marginal lands

____ Leave stubble during winter to trap snow and control erosion

____ Plant and maintain field shelterbelts or windbreaks

____ Plant fall cover crops

____ Leave crop residue on soil surface (more than 20% surface coverage)

____ Construct and maintain grassed waterways for runoff

____ Contour ploughing

____ OTHER (Please Specify)_____

14. Do you have lakes, rivers or streams on or bordering your farmlands?

___Yes ___No----IF NO, SKIP TO QUESTION 18

If Yes, what was the average distance from the edge of your croplands to the water on or bordering these parcels:

In 1990? ____ metres (yards) In 1992? ____ metres (yards)

15. If the distance changed between 1990 and 1992 (see your response to Question 14), what influence do you feel revenue insurance had on the change in distance between the edge of your croplands and the lakes, rivers or streams on or bordering your land? (Please circle the appropriate number, where "0" means it had no influence on the change, 10 means it was the only influence, and 1 through 9 are increasing levels of influence)

NO INFLUENCE										THE ONLY INFLUENCE
0	1	2	3	4	5	6	7	8	9	10

16. What influence do you feel crop insurance had on the change in distance between the edge of your croplands and the lakes, rivers or streams on or bordering your land from 1990 to 1992?

NO INFLUENCE — THE ONLY INFLUENCE

0 1 2 3 4 5 6 7 8 9 10

17. What influence do you feel NISA had on the change in distance between the edge of your croplands and the lakes, rivers or streams on or bordering your land from 1990 to 1992?

NO INFLUENCE — THE ONLY INFLUENCE

0 1 2 3 4 5 6 7 8 9 10

18. What was the average width of your field margins (e.g., fencerows, fencelines, field borders around crops, etc.):

In 1990? _____ (feet) In 1992? _____ (feet)

19. If this width changed between 1990 and 1992, what influence do you feel revenue insurance had on this change in field margins?

NO INFLUENCE — THE ONLY INFLUENCE

0 1 2 3 4 5 6 7 8 9 10

20. What influence do you feel crop insurance had on your change in field margins from 1990 to 1992?

NO INFLUENCE — THE ONLY INFLUENCE

0 1 2 3 4 5 6 7 8 9 10

21. What influence do you feel NISA had on your change in field margins from 1990 to 1992?

NO INFLUENCE — THE ONLY INFLUENCE

0 1 2 3 4 5 6 7 8 9 10

22. Do you have any wetlands (i.e., ponds, sloughs, marshes, etc.) on your lands?

___ Yes ___ No—IF NO, SKIP TO QUESTION 31

23. A. IF YES, place an "X" by the most accurate statement for the 1990 farming year:

___ I cultivated as close to the wetlands as was possible with my equipment

___ I tried to leave a border of natural vegetation around the wetlands

B. Place an "X" by the most accurate statement for the 1992 farming year:

___ I cultivated as close to the wetlands as was possible with my equipment

___ I tried to leave a border of natural vegetation around the wetlands

24. If your cultivation practices around wetlands changed between 1990 and 1992 (see your responses to 23A and 23B), what influence do you feel revenue insurance had on this change? (Please circle the appropriate number, where "0" means it had no influence, 10 means it was the only influence, and 1 through 9 are increasing levels of influence)

NO INFLUENCE — THE ONLY INFLUENCE

0 1 2 3 4 5 6 7 8 9 10

25. If your responses to 23A and 23B differ, what influence do you feel crop insurance had on this change?

NO INFLUENCE — THE ONLY INFLUENCE

0 1 2 3 4 5 6 7 8 9 10

26. If your responses to 23A and 23B differ, what influence do you feel NISA had on this change?

NO INFLUENCE — THE ONLY INFLUENCE

0 1 2 3 4 5 6 7 8 9 10

27. **Please indicate the number and estimated acreage of wetlands that you drained or filled in on your lands in the last 2 years (i.e., 1991 and 1992). If none, please write in "0" where appropriate.**

	Estimated Number Drained	Estimated Acreage Drained
Number of Permanent wetlands (wetlands that normally have water year-round, such as ponds or lakes)	____	____
Number of Semi-permanent wetlands (wetlands that have water during most years, but dry up during droughts)	____	____
Number of Seasonal wetlands (wet areas that normally dry up before mid-summer, except during wet years)	____	____

28. **If you drained or filled any wetlands in the last 2 years, what influence do you feel revenue insurance had on your decision to drain or fill?**

NO INFLUENCE 0 1 2 3 4 5 6 7 8 9 10 THE ONLY INFLUENCE

29. **What influence do you feel crop insurance had on your decision to drain or fill wetlands in the last 2 years?**

NO INFLUENCE 0 1 2 3 4 5 6 7 8 9 10 THE ONLY INFLUENCE

30. **What influence do you feel NISA had on your decision to drain or fill wetlands in the last 2 years?**

NO INFLUENCE 0 1 2 3 4 5 6 7 8 9 10 THE ONLY INFLUENCE

31. For the following crops, indicate whether the acreage grown for each crop has changed on your lands from 1990 to 1992, and the direction of the change:

CIRCLE CORRECT RESPONSE FOR EACH CROP

Spring Wheat	Increase	Decrease	No Change	Not Grown
Winter Wheat	Increase	Decrease	No Change	Not Grown
Barley	Increase	Decrease	No Change	Not Grown
Corn	Increase	Decrease	No Change	Not Grown
Canola	Increase	Decrease	No Change	Not Grown
Soybeans	Increase	Decrease	No Change	Not Grown
Lentils	Increase	Decrease	No Change	Not Grown
Peas	Increase	Decrease	No Change	Not Grown
Rye	Increase	Decrease	No Change	Not Grown
Oats	Increase	Decrease	No Change	Not Grown
Other: _____	Increase	Decrease	No Change	Not Grown
_____	Increase	Decrease	No Change	Not Grown

32. If your crop acreages changed between 1990 and 1992 (see your responses to QUESTION 31), what influence do you feel revenue insurance had on your 1992 planting decisions?

NO INFLUENCE 0 1 2 3 4 5 6 7 8 9 THE ONLY INFLUENCE 10

33. If your crop acreages changed between 1990 and 1992 (see your responses to QUESTION 31), what influence do you feel crop insurance had on your 1992 planting decisions?

NO INFLUENCE 0 1 2 3 4 5 6 7 8 9 THE ONLY INFLUENCE 10

34. If your crop acreages changed between 1990 and 1992 (see your responses to QUESTION 31), what influence do you feel NISA had on your 1992 planting decisions?

NO INFLUENCE 0 1 2 3 4 5 6 7 8 9 THE ONLY INFLUENCE 10

35. In the past 2 years, the revenue insurance program has:
(CHECK THE MOST APPROPRIATE STATEMENT):

___ Influenced me to increase the amount of fertilizers used per acre**

___ Influenced me to decrease the amount of fertilizers used per acre**

___ Not influenced me to change my fertilizer inputs from previous years

**If you changed your fertilizer inputs used per acre from 1990 to 1992, how large was that change?

___ 1-10% ___ 11-20% ___ 21-30% ___ more than 30%

36. In the past 2 years, the crop insurance program has:

___ Influenced me to increase the amount of fertilizers used per acre**

___ Influenced me to decrease the amount of fertilizers used per acre**

___ Not influenced me to change my fertilizer inputs from previous years

**If you changed your fertilizer inputs used per acre from 1990 to 1992, how large was that change?

___ 1-10% ___ 11-20% ___ 21-30% ___ more than 30%

37. In the past 2 years, the NISA program has:

___ Influenced me to increase the amount of fertilizers used per acre**

___ Influenced me to decrease the amount of fertilizers used per acre**

___ Not influenced me to change my fertilizer inputs from previous years

**If you changed your fertilizer inputs used per acre from 1990 to 1992, how large was that change?

___ 1-10% ___ 11-20% ___ 21-30% ___ more than 30%

38. In the past 2 years, the revenue insurance program has:

___ Influenced me to increase the amount of herbicides I use**

___ Influenced me to decrease the amount of herbicides I use**

___ Not influenced me to change the amounts of herbicides I have used in previous years

**If you changed your herbicide inputs from 1990 to 1992, how large was that change?

___ 1-10% ___ 11-20% ___ 21-30% ___ more than 30%

39. In the past 2 years, the crop insurance program has:

___ Influenced me to increase the amount of herbicides I use**

___ Influenced me to decrease the amount of herbicides I use**

___ Not influenced me to change the amounts of herbicides I have used in previous years

**If you changed your herbicide inputs from 1990 to 1992, how large was that change?

___ 1-10% ___ 11-20% ___ 21-30% ___ more than 30%

40. In the past 2 years, the NISA program has:

___ Influenced me to increase the amount of herbicides I use**

___ Influenced me to decrease the amount of herbicides I use**

___ Not influenced me to change the amounts of herbicides I have used in previous years

**If you changed your herbicide inputs from 1990 to 1992, how large was that change?

___ 1-10% ___ 11-20% ___ 21-30% ___ more than 30%

41. In the past 2 years, the revenue insurance program has: (CHECK THE MOST APPROPRIATE STATEMENT)

___ Influenced me to increase my total acreage of perennial forages (e.g., alfalfa)

___ Influenced me to decrease my total acreage of perennial forages

___ Not influenced me to change my total acreage of perennial forages

___ I do not grow perennial forages

42. In the past 2 years, the crop insurance program has:

___ Influenced me to increase my total acreage of perennial forages (e.g., alfalfa)

___ Influenced me to decrease my total acreage of perennial forages

___ Not influenced me to change my total acreage of perennial forages

___ I do not grow perennial forages

43. In the past 2 years, the NISA program has:

___ Influenced me to increase my total acreage of perennial forages (e.g., alfalfa)

___ Influenced me to decrease my total acreage of perennial forages

___ Not influenced me to change my total acreage of perennial forages

___ I do not grow perennial forages

44. In my view, GRIP has made farming (CHOOSE ONE):

____ Less risky ____ More risky ____ No different than before

45. What was the total value of your grain (include farm-fed grains), oilseed, and horticulture crops in 1991 excluding payments from GRIP and Crop Insurance?

___ 0 - $49,999 ___ $50,000 - $99,999 ___ $100,000 - $149,999

___ $150,000 - $199,999 ___ $200,000 - $249,000 ___ over $250,000

46. My personal contribution to NISA for the 1991 tax year was:

___ 0 - $999 ___ $1,000 - $1,999 ___ $2,000 - $2,999

___ $3,000 - $3,999 ___ $4,000 - $5,000 ___ More than $5,000

47. I believe the NISA program has made farming:

____ Less risky ____ More risky ____ No different than before

48. In the future, I intend to (CHOOSE ONLY ONE):

___ Deposit enough money in my NISA account so that it will qualify for the matching government contribution

___ Close my NISA account while I am still farming

___ Exceed the matching contribution from government so the additional funds can earn the 3% bonus interest

___ Deposit whatever I can afford into the NISA account

49. **Select one of the following six strategies that would represent the best income stabilization and investment plan for your farm (CHOOSE ONLY ONE STRATEGY)**

	First Priority	Second Priority	Third Priority
___	Put money into land or livestock; then into	NISA; and lastly into	RRSP
___	Put money into NISA; then into	land or livestock; and lastly into	RRSP
___	Put money into RRSP; then into	NISA; and lastly into	land or livestock
___	Put money into NISA; then into	RRSP; and lastly into	land or livestock
___	Put money into land or livestock; then into	RRSP; and lastly into	NISA
___	Put money into RRSP; then into	land or livestock; and lastly into	NISA

50. **Please indicate the number of animals that are present on your farming operation:**

A. Beef ____ C. Sheep ____

B. Dairy ____ D. Horses ____

51. What is your age? ____

52. **What is the highest level of schooling you have completed? (PLACE AN "X" BY THE APPROPRIATE RESPONSE)**

___ 8th grade or less ___ Some high school

___ High school diploma ___ Technical or Vocational School Diploma

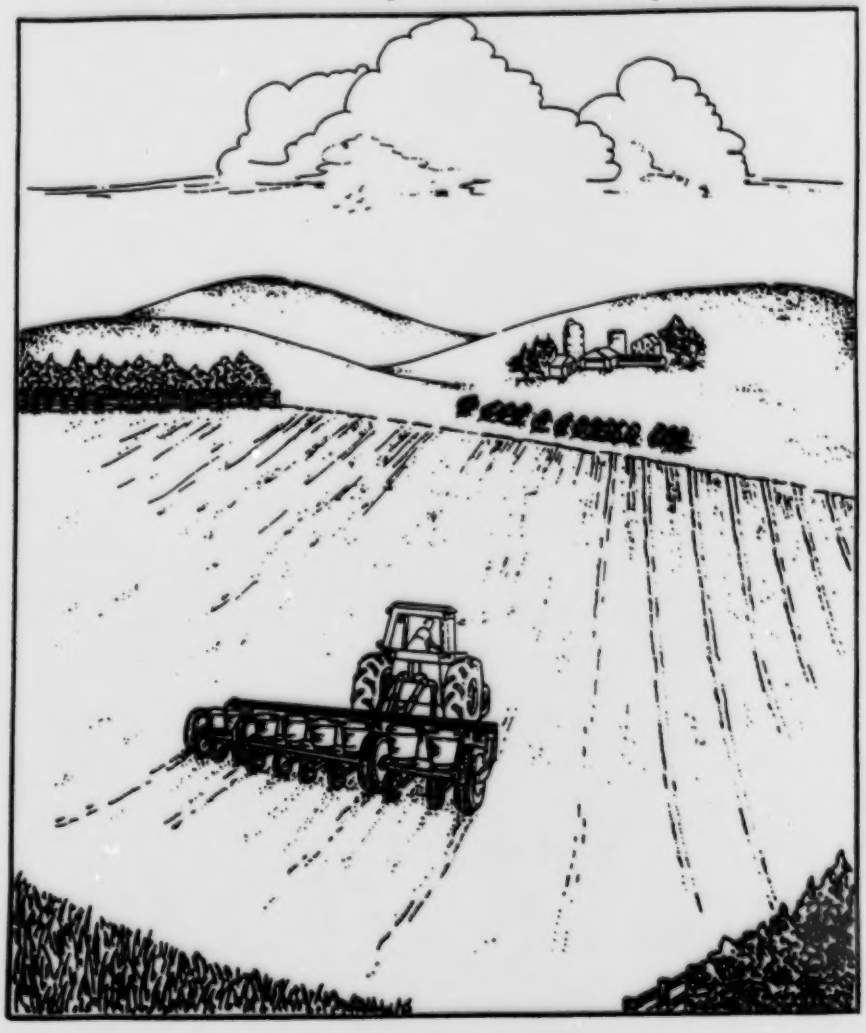
___ Some University ___ University Degree

In relation to the environment, do you have any additional comments or suggestions about the GRIP and NISA programs?

Please return this questionnaire in the enclosed postage-paid envelope. Your contribution to this project is very much appreciated. THANK YOU.

NISA ONLY VERSION OF QUESTIONNAIRE

ENVIRONMENTAL ASSESSMENT OF NISA
A National Survey of NISA Participants



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INSTRUCTIONS

Please answer all questions as best you can and do not skip over any questions unless instructed to do so. Do not write your name on the questionnaire. All your answers are STRICTLY CONFIDENTIAL and will never be used in conjunction with your name. Return the questionnaire using the addressed, postage-paid return envelop provided. Thank you very much for your assistance.

If you have any questions please call 403-299-5640.

Ce questionnaire est aussi disponible en français. Si vous préférez recevoir la version française du questionnaire, vous n'avez qu'à cocher ici _____, et à nous le retourner dans l'enveloppe-réponse affranchie ci-jointe.

Provision of the information on this document is voluntary and you may, without prejudice, decline to respond. Some information may be accessible or protected as required under the provisions of the Access to Information Act. Information that could cause you or your organization injury if released is protected from disclosure as defined in section 20 of the Access to Information Act. The Collection Registration Number is AGR/GOB-835-05381.

1. Please show how the land on your farming operation was used during the 1990 and 1992 farming seasons (NOTE: Do not provide information on your 1991 acreages and do not include land that was leased out to others).

	1990	1992
Area seeded to grains, oilseeds, or pulses (e.g., wheat, barley, corn, canola, peas, lentils, beans, sunflowers, mustards, etc.)	_____acres	_____acres
Area seeded to vegetables, berries or nursery crops (e.g., potatoes, sugar beets, shrubs, flowers, strawberries, etc.)	_____acres	_____acres
Orchard lands	_____acres	_____acres
Summerfallow:		
· Cultivated summerfallow	_____acres	_____acres
· Chemfallow	_____acres	_____acres
Perennial crops (e.g., alfalfa)	_____acres	_____acres
Improved (Seeded) Pasture	_____acres	_____acres
Unimproved Pasture:		
· Grazed Woodlands/Shrublands (areas dominated by trees or shrubs)	_____acres	_____acres
· Grazed Grasslands (areas dominated by grasses)	_____acres	_____acres
Ungrazed Grasslands	_____acres	_____acres
Ungrazed Woodlands/Shrublands (include windbreaks)	_____acres	_____acres
All other land (include barnyards, feedlots, marshes, sloughs, etc.)	_____acres	_____acres
TOTAL LAND AREA	_____acres	_____acres

2. Do you live on or within 30 kilometres (18 miles) of your farmland?

____ Yes ____ No

IF NO, in what province and county [or rural municipality (R.M.)] is your nearest land?

Province:_____ County:_____ or R.M._____

3. Please indicate the area of land that you prepared for the 1990 and 1992 seasons using the following tillage methods:

	1990	1992
Tillage which incorporated most of the crop residue into the soil	____ acres	____ acres
Tillage which retained most of the crop residue on the surface - such as minimum tillage	____ acres	____ acres
No tillage prior to seeding (for example, direct seeding into stubble)	____ acres	____ acres

4. If your tillage methods changed between 1990 and 1992, what influence do you feel NISA had on your changes in tillage methods? (Please circle the appropriate number, where "0" means it had no influence on your changes in tillage methods, 10 means it was the only influence on your changes in tillage methods, and 1 through 9 are increasing levels of influence on your changes in tillage methods)

NO INFLUENCE ... THE ONLY INFLUENCE

0 1 2 3 4 5 6 7 8 9 10

IF YOU DO NOT USE SUMMERFALLOW, PLEASE SKIP TO QUESTION 7.

5. If you use summerfallow in your rotation, about how many times did you cultivate your fallow fields in 1990 and 1992?

Number of times in 1990 ____ Number of times in 1992 ____

- If the number of cultivations changed, explain why: _____

_____

6. If your acreage of summerfallow changed between 1990 and 1992, what influence do you feel NISA had on this change? (Please circle the appropriate number, where "0" means it had no influence on your change of summerfallow, 10 means it was the only influence on your change in summerfallow, and 1 through 9 are increasing levels of influence)

NO INFLUENCE 0 1 2 3 4 5 6 7 8 9 10 THE ONLY INFLUENCE

7. Please place an "X" by each of the following management practices that you currently use on your land.

____ Establishing permanent cover on marginal lands

____ Leave stubble during winter to trap snow and control erosion

____ Plant and maintain field shelterbelts or windbreaks

____ Plant fall cover crops

____ Leave crop residue on soil surface (more than 20% surface coverage)

____ Construct and maintain grassed waterways for runoff

____ Contour ploughing

____ OTHER (Please Specify)_____

8. Do you have lakes, rivers or streams on or bordering your farmlands?

___Yes ___No—IF NO, SKIP TO QUESTION 10

If Yes, what was the average distance from the edge of your croplands to the water on or bordering these parcels:

In 1990? ____ metres (yards) In 1992? ____ metres (yards)

9. If the distance changed between 1990 and 1992 (see your response to Question 8), what influence do you feel NISA had on the change in distance between the edge of your croplands and the lakes, rivers or streams on or bordering your land? (Please circle the appropriate number, where "0" means it had no influence on the change, 10 means it was the only influence, and 1 through 9 are increasing levels of influence)

NO INFLUENCE 0 1 2 3 4 5 6 7 8 9 10 THE ONLY INFLUENCE

10. **What was the average width of your field margins (e.g., fencerows, fencelines, field borders around crops, etc.):**

In 1990? _____ (feet) In 1992? _____ (feet)

11. **If this width changed between 1990 and 1992, what influence do you feel NISA had on this change in field margins?**

NO INFLUENCE										THE ONLY INFLUENCE
0	1	2	3	4	5	6	7	8	9	10

12. **Do you have any wetlands (i.e., ponds, sloughs, marshes, etc.) on your lands?**

___ Yes ___ No—IF NO, SKIP TO QUESTION 17

13. A. IF YES, place an "X" by the most accurate statement for the 1990 farming year:

___ I cultivated as close to the wetlands as was possible with my equipment

___ I tried to leave a border of natural vegetation around the wetlands

B. Place an "X" by the most accurate statement for the 1992 farming year:

___ I cultivated as close to the wetlands as was possible with my equipment

___ I tried to leave a border of natural vegetation around the wetlands

14. **If your cultivation practices around wetlands changed between 1990 and 1992 (see your responses to 13A and 13B), what influence do you feel NISA had on this change? (Please circle the appropriate number, where "0" means it had no influence, 10 means it was the only influence, and 1 through 9 are increasing levels of influence)**

NO INFLUENCE										THE ONLY INFLUENCE
0	1	2	3	4	5	6	7	8	9	10

15. Please indicate the number and estimated acreage of wetlands that you drained or filled in on your lands in the last 2 years (i.e., 1991 and 1992). If none, please write in "0" where appropriate.

	Estimated Number Drained	Estimated Acreage Drained
Number of Permanent wetlands (wetlands that normally have water year-round, such as ponds or lakes)	____	____
Number of Semi-permanent wetlands (wetlands that have water during most years, but dry up during droughts)	____	____
Number of Seasonal wetlands (wet areas that normally dry up before mid-summer, except during wet years)	____	____

16. If you drained or filled any wetlands in the last 2 years, what influence do you feel NISA had on your decision to drain or fill?

NO INFLUENCE — THE ONLY INFLUENCE

0 1 2 3 4 5 6 7 8 9 10

17. In the past 2 years, the NISA program has:
(CHECK THE MOST APPROPRIATE STATEMENT):

____ Influenced me to increase the amount of fertilizers used per acre**

____ Influenced me to decrease the amount of fertilizers used per acre**

____ Not influenced me to change my fertilizer inputs from previous years

**If you changed your fertilizer inputs used per acre from 1990 to 1992, how large was that change?

____ 1-10% ____ 11-20% ____ 21-30% ____ more than 30%

18. In the past 2 years, the NISA program has:

___ Influenced me to increase the amount of herbicides I use***

___ Influenced me to decrease the amount of herbicides I use***

___ Not influenced me to change the amounts of herbicides I have used in previous years

***If you changed your herbicide inputs from 1990 to 1992, how large was that change?

___ 1-10% ___ 11-20% ___ 21-30% ___ more than 30%

19. For the following crops, indicate whether the acreage grown for each crop has changed on your lands from 1990 to 1992, and the direction of the change:

CIRCLE CORRECT RESPONSE FOR EACH CROP

Spring Wheat	Increase	Decrease	No Change	Not Grown
Winter Wheat	Increase	Decrease	No Change	Not Grown
Barley	Increase	Decrease	No Change	Not Grown
Corn	Increase	Decrease	No Change	Not Grown
Canola	Increase	Decrease	No Change	Not Grown
Soybeans	Increase	Decrease	No Change	Not Grown
Lentils	Increase	Decrease	No Change	Not Grown
Peas	Increase	Decrease	No Change	Not Grown
Rye	Increase	Decrease	No Change	Not Grown
Oats	Increase	Decrease	No Change	Not Grown
Other:_____	Increase	Decrease	No Change	Not Grown
_____	Increase	Decrease	No Change	Not Grown

20. If your crop acreages changed between 1990 and 1992 (see your responses to QUESTION 19), what influence do you feel NISA had on your 1992 planting decisions?

NO INFLUENCE — THE ONLY INFLUENCE

0 1 2 3 4 5 6 7 8 9 10

21. In the past 2 years, the NISA program has: (CHECK THE MOST APPROPRIATE STATEMENT)

___ Influenced me to increase my total acreage of perennial forages (e.g., alfalfa)

___ Influenced me to decrease my total acreage of perennial forages

___ Not influenced me to change my total acreage of perennial forages

___ I do not grow perennial forages

22. What was the total value of your grain (include farm-fed grains), oilseed, and horticulture crops in 1991 excluding payments from GRIP and Crop Insurance?

___ 0 - $49,999 ___ $50,000 - $99,999 ___ $100,000 - $149,999

___ $150,000 - $199,999 ___ $200,000 - $249,000 ___ over $250,000

23. My personal contribution to NISA for the 1991 tax year was:

___ 0 - $999 ___ $1,000 - $1,999 ___ $2,000 - $2,999

___ $3,000 - $3,999 ___ $4,000 - $5,000 ___ More than $5,000

24. I believe the NISA program has made farming:.

___ Less risky ___ More risky ___ No different than before

25. In the future, I intend to (CHOOSE ONLY ONE):

___ Deposit enough money in my NISA account so that it will qualify for the matching government contribution

___ Close my NISA account while I am still farming

___ Exceed the matching contribution from government so the additional funds can earn the 3% bonus interest

___ Deposit whatever I can afford into the NISA account

26. Select one of the following six strategies that would represent the best income stabilization and investment plan for your farm (CHOOSE ONLY ONE STRATEGY)

First Priority	Second Priority	Third Priority
___ Put money into land or livestock; then into	NISA; and lastly into	RRSP
___ Put money into NISA; then into	land or livestock; and lastly into	RRSP
___ Put money into RRSP; then into	NISA; and lastly into	land or livestock
___ Put money into NISA; then into	RRSP; and lastly into	land or livestock
___ Put money into land or livestock; then into	RRSP; and lastly into	NISA
___ Put money into RRSP; then into	land or livestock; and lastly into	NISA

27. Please indicate the number of animals that are present on your farming operation:

A. Beef ____ C. Sheep ____

B. Dairy ____ D. Horses ____

28. What is your age? ____

29. What is the highest level of schooling you have completed?
(PLACE AN "X" BY THE APPROPRIATE RESPONSE)

___ 8th grade or less ___ Some high school

___ High school diploma ___ Technical or Vocational School Diploma

___ Some University ___ University Degree

In relation to the environment, do you have any additional comments or suggestions about the NISA program?

Please return this questionnaire in the enclosed postage-paid envelope. Your contribution to this project is very much appreciated. THANK YOU.

APPENDIX IV

SUMMARIES OF LETTERS AND BRIEFS

TITLE	The Environmental Effects of GRIP and NISA: A Brief Submitted by the Saskatchewan Soil Conservation Association to Agriculture Canada.
SOURCE	Saskatchewan Soil Conservation Association Regina, Saskatchewan Oct. 29, 1992
PROVINCE	Saskatchewan
ENVIRONMENTAL CONCERNS	<u>GRIP</u> • exclusion of forages from coverage - concerns that forages on fragile and poor quality land will be replaced by crops - concerns that forages will be removed from annual crop rotations • Production based on historical prices - soil, nutrients, water and energy are used up in production • Other Land Use Issues - programs based on production distort the use of resources <u>NISA</u> • favours grain and oilseed production • failure to cover forage and livestock production
POSITIVE ASPECTS	• less summerfallow with increased cultivated acres - promotes continuous cropping on fragile lands that are already under production
RECOMMENDATIONS	• exclusion of coverage for newly broken native grasslands, wetlands or forested areas

TITLE	Environmental Assessment of GRIP and NISA
SOURCE	Canadian Fertilizer Institute Ottawa, Ontario October 30, 1992
PROVINCES	• Saskatchewan • Manitoba • Alberta • British Columbia
ENVIRONMENTAL CONCERNS	<u>GRIP</u> • economic stress has the potential to force farmers to compromise optimal environmental farming practices • mining the soil resource resulting in the loss of soil nutrients and declines in soil organic matter levels • summerfallow - increased erosion and loss of essential mineral nutrients • fertilizer industry supports use of crop rotations and conservation tillage • inefficient use of mineral fertilizers and other plant nutrients (proper fertilizer management) • nitrate leaching and phosphorus runoff - groundwater contamination and surface water • conservation of soil water and air resources • education on appropriate mineral fertilizer use • on site-specific fertilizer management strategies • manure management • water conservation - interaction of fertilizer • monoculture system with minimal use of fertilizer has contributed to soil degradation
GENERAL FARMING PRACTICES	• GRIP and NISA - programs should be structured to ensure environmental degradation does not occur as an unintended side effect. - are farmers practising sound land stewardship? - encourage farmers to maintain a sustainable agricultural base. - ensure that negative effects on long-term production capabilities do not occur at times of financial stress i.e., efficient use of mineral fertilizers and other plant nutrients. - enhance and support superior farm management.

TITLE	**Environmental Assessment of GRIP and NISA**
SOURCE	**Ontario Corn Producers Association** **Guelph, Ontario** **March 12, 1993**
PROVINCE	**Ontario**
ENVIRONMENTAL CONCERNS	**Ontario Concerns:** **1. Water Erosion** **2. Ground Water Nitrate Levels** **3. Disposal/Usage of Animal Manure** **4. Air Pollution (ground-level ozone)** **GRIP** • **no environmental concerns due to program payouts based on individual historic average farm yield records.** **NISA** • **livestock and poultry products are not eligible for contributions** • **causing farm splitting into separate operations** • **failure to include crops such as tobacco and coloured beans.**

SOURCE	Back to the Farm Research Foundation Davidson, Saskatchewan October 26, 1992
PROVINCE	Saskatchewan
ENVIRONMENTAL CONCERNS	<u>GRIP</u> • encourages maximum production • creates pressure to use more and sometimes cheaper chemicals • chemical residues pollute surface water • granular fertilizer may wind drift on summerfallow <u>FEDERAL DEPARTMENT OF AGRICULTURE</u> • Sec. 2 of Bill 98 - farmers not aware of commitment to carry out sound management practices to ensure environmental stability • effects of chemicals on environment • chemical companies continue to promote agriculture chemicals in a manner detrimental to the environment, food and water • results of chemical pollution on ground and surface water and the soil have not been published • effects of chemicals on micro-organisms is not clear • soil salinity (GRIP and NISA)
RECOMMENDATIONS	• better public awareness of chemicals and their effects on the environment • programs to encourage organic farming • improve soil fertility with legumes, rotations, manure and compost • discontinue GRIP - NISA payments if farmers fail to practice soil conservation on their lands

SOURCE	The Nature Conservancy of Canada Calgary, Alberta	October 5, 1992
PROVINCES	Alberta Manitoba Saskatchewan	grassland region grassland region grassland region
ENVIRONMENTAL CONCERNS	<u>GRIP and NISA</u> encourage native prairies to be broken to take advantage of incentive programs even when the land may be of marginal productivity	

TITLE	Environmental Assessment of GRIP and NISA
SOURCE	Brewing and Malting Barley Research Institute Aug. 26, 1992
ENVIRONMENTAL CONCERNS	None, they were unaware of any environmental effects

SOURCE	Ducks Unlimited Canada Winnipeg, Manitoba September 11, 1992
PROVINCES	Canada
ENVIRONMENTAL CONCERNS	<u>GRIP</u> • program is based on production of grains and oilseeds only • payments based on acreage of production • forages not eligible for coverage • premiums and payouts are crop specific • encourages cropping of marginal land • all the above reduce incentives for farm diversity especially forages and livestock <u>NISA</u> • does not include forages and livestock

TITLE	Saskatchewan Eco-Network Newsletter
SOURCE	Saskatchewan Eco-Network Saskatoon, Saskatchewan August 27, 1993
PROVINCE	Southern Saskatchewan
ENVIRONMENTAL CONCERNS	<u>GRIP and NISA</u> • encourage monocultures • organic farming → bad for the soil from only "green" inputs and no chemicals • encourage over-production of some crops • cropping of marginal lands • discourage forage crops from being produced
POSITIVE ASPECTS	• money received could be beneficial if farmers are required to put a portion of it toward improving their care of the soil

TITLE	Environmental Assessment of GRIP and NISA
SOURCE	Western Barley Growers Association Calgary, Alberta November 18, 1992
PROVINCES	British Columbia, Alberta, Saskatchewan, Manitoba, Ontario
ENVIRONMENTAL CONCERNS	<u>GRIP (B.C., Alberta, Manitoba)</u> • have an insurance scheme • encourages cropping marginal land that should be in forage or range land • encourages farmers in low grain price years to cut back on inputs • causes mining of the soil <u>GRIP (Saskatchewan and Ontario</u> • motivates the farmer to use his land in a manner to give him the most profit return • encourages sound environmental practices such as rotations, and proper choice of crops <u>NISA</u> • no environmental issues

TITLE	Northwest Soil Management Association
SOURCE	Swan River, Manitoba October 22, 1992
AUTHOR	Svojanovski, F. (chairman)
PROVINCE	Manitoba
ENVIRONMENTAL CONCERNS	Soil Erosion
POSITIVE ASPECTS	GRIP • significant increase in the number of zero-tilled and minimum tilled fields GRIP and NISA • good environmentally sound farming practices

SOURCE	Ontario Institute of Agrologists (Agriculture Institute of Canada) Guelph, Ontario November 2, 1992
AUTHOR	McCorquodale, B. (chairman)
PROVINCE	Ontario
ENVIRONMENTAL CONCERNS	<u>GRIP</u> • may influence cropping decisions but otherwise environmentally neutral - i.e., rotations over longer period of time due to a higher gross margin. <u>NISA</u> • no adverse impacts on the environment

TITLE	Environmental Assessment Review of GRIP and NISA
SOURCE	Saskatchewan Wheat Pool Regina, Saskatchewan October 30, 1992
PROVINCE	Saskatchewan
ENVIRONMENTAL CONCERNS	GRIP "1" (Original GRIP Program - 1991) • discourages diversification • encourages the potential for moral hazard resulting in improper land and agronomic practices • exclusion of forages • no provision for conservation incentives • caused greater soil degradation as a result of more cropping with less inputs GRIP "2" (1992 Program) • discourages forages • discourages diversification • no conservation incentives NISA • failure of coverages for forages General Concerns Related to Current Farming Practices 1. Soil degradation in terms of quality losses and erosion 2. Use of fragile lands 3. Water utilization and quality 4. Natural wildlife habitat 5. Use and application of production technology

TITLE	Submission for the First Environmental Assessment of the GRIP and NISA Programs
SOURCE	Organic Producers Association of Manitoba Co-op Ltd. Virden, Manitoba November 3, 1992
PROVINCE	Manitoba
ENVIRONMENTAL CONCERNS	<u>GRIP</u> • encourages farming practices that are not sustainable • discriminates against organic farmers • no incentives to practice proper crop rotations • no accountability for soil/water conservation or protection • encourages heavy nitrogen fertilizer use • causes pollution of water tables through leaching of nitrates • pollution by herbicides, pesticides, nitrates <u>NISA</u> • none
RECOMMENDATIONS	• incentives must be created for environmentally sustainable production • provide and additional 25% incentive to certified organic producers

SOURCE	Farmer from Colonsay, Saskatchewan October 30, 1992
PROVINCE	Saskatchewan
ENVIRONMENTAL CONCERNS	GRIP Chemical pollutants into lakes, rivers, and wells; high costs associated with ensuing clean-up.
RECOMMENDATIONS	• Government should provide rewards through GRIP and NISA for organic producers and for adopting sound management practices and ensuring environmental sustainability

TITLE	Comments on the Environmental Assessment of GRIP and NISA
AUTHOR	Wishart, I.R. Portage la Prairie, Manitoba November 13, 1992
PROVINCE	Manitoba
ENVIRONMENTAL CONCERNS	<u>GRIP</u> • promotes planting acres normally in forages, summerfallow etc. • radical swings to crops with higher coverages with little regard to experience, rotations etc. • increased erosion on unsuitable land • improper rotations for disease, weeds, chemicals, etc. • failure to cover forages • brings marginal land into production (H, I, J soil classes in production) <u>NISA</u> • promotes maximum production • costly in terms of soil erosion and loss of habitat

APPENDIX V

SUMMARY TABLES FROM MAIL SURVEY

APPENDIX V

TABLE 1

Number (n) of Alberta producers sampled within each soil zone who: provided information on their tillage practices, changed the proportion(s) of their tillage acreages between 1990 and 1992, and claimed they were influenced to change by the NISA program.

	SOIL ZONE				
	A1	A2	A3	B3	C2
Number of producers who provided information on their tillage practices	295	290	313	318	278
Number of producers who changed the proportion of their **zero-tillage acreage** between 1990 and 1992	13 (1⁻)[a]	28 (3⁺)	7 (1⁺)	14 (0)	7 (1⁻1⁺)
Associated change in total zero-tillage acreage	-0.2%	+0.4%	+0.4%	-	+0.0%
Number of producers who changed the proportion of their **minimum-tillage acreage** between 1990 and 1992	39 (2⁻,1⁺)	43 (1⁻,2⁺)	28 (1⁻,1⁺)	37 (0)	23 (1⁻)
Number of producers who changed the proportion of their **conventional-tillage acreage** between 1990 and 1992	39 (1⁻,1⁺)	32 (3⁻)	28 (2⁻,1⁺)	36 (0)	27 (1⁻,1⁺)

[a] Numbers in parentheses represent the number of producers who claim they were influenced by the NISA program, where " ⁻ " indicates producers who were influenced to decrease and " ⁺ " indicates producers who were influenced to increase their respective acreages.

APPENDIX V

TABLE 2

Numbers (n) of Saskatchewan producers sampled within each soil zone who: provided information on their tillage practices, changed the proportion(s) of their tillage acreages between 1990 and 1992, and claimed they were influenced to change by the NISA program.

	Soil Zone			
	A1	A2	A3	C2
Number of producers who provided information on their tillage practices	289	272	250	237
Number of producers who changed the proportion of their **zero-tillage acreage** between 1990 and 1992	51 (1⁻)*	42 (1⁺)	23 (1⁺)	16 (0)
Associated change in total zero-tillage acreage	-0.1%	+0.2%	+0.1%	-
Number of producers who changed the proportion of their **minimum-tillage acreage** between 1990 and 1992	52 (0)	59 (1⁺)	45 (3⁺)	39 (1⁺)
Number of producers who changed the proportion of their **conventional-tillage acreage** between 1990 and 1992	42 (1⁺)	55 (2⁻)	38 (3⁻)	44 (1⁻)

* Numbers in parentheses represent the number of producers who claim they were influenced by the NISA program, where " ⁻ " indicates producers who were influenced to decrease and " ⁺ " indicates producers who were influenced to increase their respective acreages.

APPENDIX V

TABLE 3

Number (n) of Manitoba producers sampled within each soil zone who: provided information on their tillage practices, changed the proportion(s) of their tillage acreages between 1990 and 1992, and claimed they were influenced to change by the NISA program.

	SOIL ZONE		
	A3	A4	C2
Number of producers who provided information on their tillage practices	346	309	284
Number of producers who changed the proportion of their **zero-tillage acreage** between 1990 and 1992	44 (1⁻)[a]	10 (0)	6 (1⁺)
Associated change in total zero-tillage acreage	-0.0%	-	+0.0%
Number of producers who changed the proportion of their **minimum-tillage acreage** between 1990 and 1992	57 (1⁻,1⁺)	37 (2⁻,1⁺)	19 (3⁺)
Number of producers who changed the proportion of their **conventional-tillage acreage** between 1990 and 1992	52 (2⁺,1⁻)	39 (2⁺)	23 (4⁻)

[a] Numbers in parentheses represent the number of producers who claimed they were influenced by the NISA program, where " ⁻ " indicates producers who were influenced to decrease and " ⁺ " indicates producers who were influenced to increase their respective acreages.

APPENDIX V

TABLE 4

Number (n) of Ontario producers sampled within each soil zone who: provided information on their tillage practices, changed the proportion(s) of their tillage acreages between 1990 and 1992, and claimed they were influenced to change by the NISA program.

	SOIL ZONE	
	C1	E1
Number of producers who provided information on their tillage practices	345	344
Number of producers who changed the proportion of their **zero-tillage acreage** between 1990 and 1992	57 (2',6⁺)*	28 (2⁺)
Associated change in total zero-tillage acreage	+0.1%	+0.3%
Number of producers who changed the proportion of their **minimum-tillage acreage** between 1990 and 1992	74 (5',6⁺)	77 (6',10⁺)
Number of producers who changed the proportion of their **conventional-tillage acreage** between 1990 and 1992	98 (12',5⁺)	88 (12',4⁺)

* Numbers in parentheses represent the number of producers who claim they were influenced by the NISA program, where " ' " indicates producers who were influenced to decrease and " + " indicates producers who were influenced to increase their respective acreages.

APPENDIX V

TABLE 5

Numbers (n) of British Columbia, Prince Edward Island, Nova Scotia and Newfoundland producers sampled who: provided information on their tillage practices, changed the proportion(s) of their tillage acreages between 1990 and 1992, and claimed they were influenced to change by the NISA program.

	PROVINCE			
	B.C.	PEI	N.S	N.F
Number of producers who provided information on their tillage practices	232	141	65	17
Number of producers who changed the proportion of their **zero-tillage acreage** between 1990 and 1992	13 (3⁺)[a]	14 (1⁻,2⁺)	4 (0)	3 (0)
Associated change in total zero-tillage acreage	+0.4%	-0.0%	-	-
Number of producers who changed the proportion of their **minimum-tillage acreage** between 1990 and 1992	26 (2⁻,1⁺)	23 (3⁻,1⁺)	9 (1⁻)	5 (0)
Number of producers who changed the proportion of their **conventional-tillage acreage** between 1990 and 1992	27 (3⁻,1⁺)	25 (2⁻,2⁺)	11 (1⁺)	8 (0)

[a] Numbers in parentheses represent the number of producers who claimed they were influenced by the NISA program, where " ⁻ " indicates producers who were influenced to decrease and " ⁺ " indicates producers who were influenced to increase their respective acreages.

APPENDIX V

TABLE 6

Number (n) of Alberta producers sampled within each soil zone who: provided information on their summerfallow practices, changed the proportion of their summerfallow acreage between 1990 and 1992, and claimed they were influenced to change by the NISA program.

	SOIL ZONE				
	A1	A2	A3	B3	C2
Number of producers who provided information on their summerfallow practices	336	333	351	364	330
Number of producers who changed the proportion of their summerfallow acreage between 1990 and 1992	132	167	132	169	166
Number of producers who claim they were influenced to change by the NISA program	4[-] 3[+]	5[-]	4[-] 1[+]	5[-] 4[+]	8[-] 2[+]
Associated change in total summerfallow acreage	-0.1%	-0.5%	-0.3%	-0.7%	-0.3%

[-] indicate producers who were influenced to decrease
[+] indicate producers who were influenced to increase

APPENDIX V

TABLE 7

Numbers (n) of Saskatchewan producers sampled within each soil zone who: provided information on their summerfallow practices, changed the proportion of their summerfallow acreage between 1990 and 1992, and claimed they were influenced to change by the 1992 NISA program.

	Soil Zone			
	A1	A2	A3	C2
Number of producers who provided information on their summerfallow practices	328	327	310	302
Number of producers who changed the proportion of their summerfallow acreage between 1990 and 1992	140	199	206	209
Number of producers who claim they were influenced to change by the NISA program	1[-] 2[+]	6[-] 5[+]	5[-] 3[+]	5[-] 3[+]
Associated change in total summerfallow acreage	+0.0%	-0.2%	-0.2%	-1.0%

[-] indicate producers who were influenced to decrease
[+] indicate producers who were influenced to increase

APPENDIX V

TABLE 8

Number (n) of Manitoba producers sampled within each soil zone who: provided information on their summerfallow practices, changed the proportion of their summerfallow acreage between 1990 and 1992, and claimed they were influenced to change by the NISA program.

	SOIL ZONE		
	A3	A4	C2
Number of producers who provided information on their summerfallow practices	388	361	334
Number of producers who changed the proportion of their summerfallow acreage between 1990 and 1992	116	171	203
Number of producers who claim they were influenced to change by the NISA program	2[a] 2[+]	5[-] 2[+]	9[-] 5[+]
Associated change in total summerfallow acreage	+0.1%	-0.2%	-0.2%

[a] [-] indicate producers who were influenced to decrease
[+] indicate producers who were influenced to increase

APPENDIX V

TABLE 9

Number (n) of British Columbia producers sampled who: provided information on their summerfallow practices, changed the proportion of their summerfallow acreage between 1990 and 1992, and claimed they were influenced to change by the NISA program.

	SOIL ZONE
	C2
Number of producers who provided information on their summerfallow practices	292
Number of producers who changed the proportion of their summerfallow acreage between 1990 and 1992	154
Number of producers who claim they were influenced to change by the NISA program	6[a] 2[a]
Associated change in total summerfallow acreage	-0.8%

[a] (-) indicate producers who were influenced to decrease
(+) indicate producers who were influenced to increase

APPENDIX V

TABLE 10

Number (n) of Alberta producers sampled within each soil zone who: provided information on their summerfallow cultivation practices, changed the number of their summerfallow cultivations between 1990 and 1992, and claimed they were influenced to change by the NISA program.

	SOIL ZONE				
	A1	A2	A3	B3	C2
Number of producers who provided information on their summerfallow cultivation practices	216	224	147	174	156
Number of producers who changed the number of their summerfallow cultivations between 1990 and 1992	111	106	84	84	78
Number of producers who claim they were influenced to change by the NISA program	0	0	1[-]	0	0

[-] indicate producers who were influenced to decrease
[+] indicate producers who were influenced to increase

APPENDIX V

TABLE 11

Numbers (n) of Saskatchewan producers sampled within each soil zone who: provided information on their summerfallow cultivation practices, changed the number of their summerfallow cultivations between 1990 and 1992, and claimed they were influenced to change by the 1992 NISA program.

	Soil Zone			
	A1	A2	A3	C2
Number of producers who provided information on their summerfallow cultivation practices	290	293	243	221
Number of producers who changed the number of their summerfallow cultivations between 1990 and 1992	101	116	86	80
Number of producers who claim they were influenced to change by the NISA program	0	0	0	0

APPENDIX V

TABLE 12

Number (n) of Manitoba producers sampled within each soil zone who: provided information on their summerfallow cultivation practices, changed the number of their summerfallow cultivations between 1990 and 1992, and claimed they were influenced to change by the NISA program.

	SOIL ZONE		
	A3	A4	C2
Number of producers who provided information on their summerfallow cultivation practices	115	157	192
Number of producers who changed the number of their summerfallow cultivations between 1990 and 1992	52	66	61
Number of producers who claim they were influenced to change by the NISA program	0	0	0

APPENDIX V

TABLE 13

Number (n) of British Columbia producers sampled who: provided information on their summerfallow cultivation practices, changed the number of their summerfallow cultivations between 1990 and 1992, and claimed they were influenced to change by the NISA program.

	SOIL ZONE
	C2
Number of producers who provided information on their summerfallow cultivation practices	169
Number of producers who changed the number of their summerfallow cultivations between 1990 and 1992	76
Number of producers who claim they were influenced to change by the GRIP program	0

APPENDIX V

TABLE 14

Number (n) of Alberta producers sampled within each soil zone who: had riparian areas on their properties, changed the width of the riparian zones between 1990 and 1992, and were influenced to change by the NISA program.

	SOIL ZONE				
	A1	A2	A3	B3	C2
Number of producers with riparian areas on their properties	39	81	90	104	148
Number of producers who changed the width of the riparian zones between 1990 and 1992	2	3	6	8	14
Number of producers who were influenced to change by the NISA program	0	0	1*	1*	2*

* (-) indicate producers who were influenced to decrease
(+) indicate producers who were influenced to increase

APPENDIX V

TABLE 15

Numbers (n) of Saskatchewan producers sampled within each soil zone who: had riparian areas on their properties, changed the width of their riparian zones between 1990 and 1992, and were influenced to change by the 1992 NISA program.

	Soil Zone			
	A1	A2	A3	C2
Number of producers with riparian areas on their properties	24	33	81	99
Number of producers who changed the width of the riparian zones between 1990 and 1992	0	4	10	7
Number of producers who were influenced to change by the NISA program	0	2*	0	0

* (-) indicate producers who were influenced to decrease
(+) indicate producers who were influenced to increase

APPENDIX V

TABLE 16

Number (n) of Manitoba producers sampled within each soil zone who: had riparian areas on their properties, changed the width of their riparian zones between 1990 and 1992, and claimed they were influenced to change by the NISA program.

	SOIL ZONE		
	A3	A4	C2
Number of producers with riparian areas on their properties	115	134	172
Number of producers who changed the width of their riparian zones between 1990 and 1992	5	4	13
Number of producers who were influenced to change by the NISA program	1(+)	1(-)	0

(-) indicate producers who were influenced to decrease
(+) indicate producers who were influenced to increase

APPENDIX V

TABLE 17

Number (n) of Ontario producers sampled within each soil zone who: had riparian areas on their properties, changed the width of the riparian zones between 1990 and 1992, and were influenced to change by the NISA programs.

	SOIL ZONE	
	C1	E1
Number of producers with riparian areas on their properties	201	202
Number of producers who changed the width of the riparian zones between 1990 and 1992	21	32
Number of producers who were influenced to change by the NISA program	6(+)	7(+)

(-) indicate producers who were influenced to decrease
(+) indicate producers who were influenced to increase

APPENDIX V

TABLE 18

Numbers (n) of British Columbia, Prince Edward Island, Nova Scotia and Newfoundland producers sampled who: had riparian areas on their properties, changed the width of the riparian zone between 1990 and 1992, and were influenced to change by the NISA program.

	PROVINCE			
	B.C.	PEI	N.S	N.F
Number of producers with riparian areas on their properties	95	102	69	8
Number of producers who changed the width of the riparian zones between 1990 and 1992	3	6	6	1
Number of producers who were influenced to change by the NISA program	0	2[+a]	0	0

[a] (-) indicate producers who were influenced to decrease
(+) indicate producers who were influenced to increase

APPENDIX V

TABLE 19

Number (n) of Alberta producers sampled within each soil zone who: provided information on the widths of their field margins, changed the width of their field margins between 1990 and 1992, and were influenced to change by the NISA program.

	SOIL ZONE				
	A1	A2	A3	B3	C2
Number of producers who provided information on the widths of their field margins	261	294	320	313	272
Number of producers who changed the width of their field margins between 1990 and 1992	8	10	8	6	6
Number of producers who were influenced to change by the NISA program	0	0	0	0	0

APPENDIX V

TABLE 20

Numbers (n) of Saskatchewan producers sampled within each soil zone who: provided information on the widths of their field margins, changed the width of their field margins between 1990 and 1992, and were influenced to change by the 1992 NISA program.

	Soil Zone			
	A1	A2	A3	C2
Number of producers who provided information on the widths of their field margins	237	270	263	251
Number of producers who changed the width of their field margins between 1990 and 1992	6	3	6	5
Number of producers who were influenced to change by the NISA program	1[a] 1[+]	1[-] 1[+]	1[-]	1[-]

[a] [-] indicate producers who were influenced to decrease
[+] indicate producers who were influenced to increase

APPENDIX V

TABLE 21

Number (n) of Manitoba producers sampled within each soil zone who: provided information on the widths of their field margins, changed the width of their field margins between 1990 and 1992, and were influenced to change by the NISA program.

	SOIL ZONE		
	A3	A4	C2
Number of producers who provided information on the widths of their field margins	322	318	284
Number of producers who changed the width of their field margins between 1990 and 1992	8	6	8
Number of producers who were influenced to change by the NISA program	2[-] 2[+]	1[+]	2[-] 1[+]

[a] [-] indicate producers who were influenced to decrease
[+] indicate producers who were influenced to increase

APPENDIX V

TABLE 22

Number (n) of Ontario producers sampled within each soil zone who: provided information on the widths of their field margins, changed the width of their field margins between 1990 and 1992, and were influenced to change by the NISA programs.

	SOIL ZONE	
	C1	E1
Number of producers who provided information on the widths of their field margins	398	399
Number of producers who changed the width of their field margins between 1990 and 1992	20	25
Number of producers who were influenced to change by the NISA program	1[-]	3[-]

[-] indicate producers who were influenced to decrease
[+] indicate producers who were influenced to increase

APPENDIX V

TABLE 23

Numbers (n) of British Columbia, Prince Edward Island, Nova Scotia and Newfoundland producers sampled who: provided information on the widths of their field margins, changed the width of their field margins between 1990 and 1992, and were influenced to change by the NISA program.

	PROVINCE			
	B.C.	PEI	N.S	N.F
Number of producers who provided information on the widths of their field margins	252	134	72	22
Number of producers who changed the width of their field margins between 1990 and 1992	5	8	2	1
Number of producers who were influenced to change by the NISA program	0	2* 1*	0	1*

* (-) indicate producers who were influenced to decrease
(+) indicate producers who were influenced to increase

APPENDIX V

TABLE 24

Number (n) of Alberta producers sampled within each soil zone who: indicated they had wetlands on their properties, changed the width of their wetland margins between 1990 and 1992, and were influenced to change by the NISA program.

	SOIL ZONE				
	A1	A2	A3	B3	C2
Number of producers who had wetlands on their properties	102	169	224	238	183
Number of producers who changed their wetland margins between 1990 and 1992	1	4	3	3	2
Number of producers who were influenced to change by the NISA program	0	2[*,1]	0	1[*]	0

* [-] indicate producers who were influenced to decrease
[+] indicate producers who were influenced to increase

APPENDIX V

TABLE 25

Numbers (n) of Saskatchewan producers sampled within each soil zone who: indicated they had wetlands on their properties, changed the width of their wetland margins between 1990 and 1992, and were influenced to change by the 1992 NISA program.

	Soil Zone			
	A1	A2	A3	C2
Number of producers who had wetlands on their properties	101	198	205	196
Number of producers who changed their wetland margins between 1990 and 1992	1	1	2	6
Number of producers who were influenced to change by the NISA program	0	0	0	2*

* (-) indicate producers who were influenced to decrease
(+) indicate producers who were influenced to increase

APPENDIX V

TABLE 26

Number (n) of Manitoba producers sampled within each soil zone who: indicated they had wetlands on their properties, changed the widths of their wetland margins between 1990 and 1992, and were influenced to change by the NISA program.

	SOIL ZONE		
	A3	A4	C2
Number of producers who had wetlands on their properties	180	169	265
Number of producers who changed their wetland margins between 1990 and 1992	5	3	3
Number of producers who were influenced to change by the NISA program	1[+a]	0	2[+]

[-] indicate producers who were influenced to decrease
[+] indicate producers who were influenced to increase

APPENDIX V

TABLE 27

Number (n) of Ontario producers sampled within each soil zone who: indicated they had wetlands on their properties, changed the width of their wetland margins between 1990 and 1992, and were influenced to change by the NISA programs.

	SOIL ZONE	
	C1	E1
Number of producers who had wetlands on their properties	135	182
Number of producers who changed their wetland margins between 1990 and 1992	2	2
Number of producers who were influenced to change by the NISA program	1**	0

* (-) indicate producers who were influenced to decrease
(+) indicate producers who were influenced to increase

APPENDIX V

TABLE 28

Numbers (n) of British Columbia, Prince Edward Island, Nova Scotia and Newfoundland producers sampled who: indicated they had wetlands on their properties, changed the width of their wetland margins between 1990 and 1992, and were influenced to change by the NISA program.

	PROVINCE			
	B.C.	PEI	N.S	N.F
Number of producers who had wetlands on their properties	151	73	54	11
Number of producers who changed their wetland margins between 1990 and 1992	3	5	1	0
Number of producers who were influenced to change by the NISA program	0	2[*]	0	0

[*] (-) indicate producers who were influenced to decrease
(+) indicate producers who were influenced to increase

APPENDIX V

TABLE 29

Number (n) of Alberta producers sampled within each soil zone who: indicated they had wetlands on their properties, drained ≥ 1 wetland on their properties between 1990 and 1992, and were influenced to drain by the NISA program.

	SOIL ZONE				
	A1	A2	A3	B3	C2
Number of producers with wetlands on their properties	102	169	224	238	183
Number of producers who drained ≥ 1 wetland on their properties between 1990 and 1992	22	18	41	61	29
Number of producers who were influenced to drain by the NISA program	0	0	2	4	2

APPENDIX V

TABLE 30

Numbers (n) of Saskatchewan producers sampled within each soil zone who: indicated that they had wetlands on their properties, drained ≥ 1 wetland on their properties between 1990 and 1992, and were influenced to drain by the 1992 NISA program.

	Soil Zone			
	A1	A2	A3	C2
Number of producers with wetlands on their properties	101	198	205	196
Number of producers who drained ≥ 1 wetlands on their properties between 1990 and 1992	19	33	30	24
Number of producers who were influenced to drain by the NISA program	1	1	0	1

APPENDIX V

TABLE 31

Number (n) of Manitoba producers sampled within each soil zone who: indicated they had wetlands on their properties, drained $\geq$ 1 wetland on their properties between 1990 and 1992, and were influenced to drain by the NISA program.

	SOIL ZONE		
	A3	A4	C2
Number of producers who had wetlands on their properties	180	169	265
Number of producers who drained $\geq$ 1 wetlands on their properties between 1990 and 1992	33	33	43
Number of producers who were influenced to drain by the NISA program	1	0	2

APPENDIX V

TABLE 32

Number (n) of Ontario producers sampled within each soil zone who: indicated they had wetlands on their properties, drained ≥ 1 wetland on their properties between 1990 and 1992, and were influenced to drain by the NISA program.

	SOIL ZONE	
	C1	E1
Number of producers with wetlands on their properties	135	182
Number of producers who drained ≥ 1 wetlands on their properties between 1990 and 1992	13	13
Number of producers who were influenced to drain by the NISA program	2	1

APPENDIX V

TABLE 33

Numbers (n) of British Columbia, Prince Edward Island, Nova Scotia and Newfoundland producers sampled who: indicated they had wetlands on their properties, drained $\geq$ 1 wetland on their properties between 1990 and 1992, and were influenced to drain by the NISA program.

	PROVINCE			
	B.C.	PEI	N.S	N.F
Number of producers with wetlands on their properties	151	73	54	11
Number of producers who drained $\geq$ 1 wetlands on their properties between 1990 and 1992	28	13	8	0
Number of producers who were influenced to drain by the NISA program	2	4	1	0